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W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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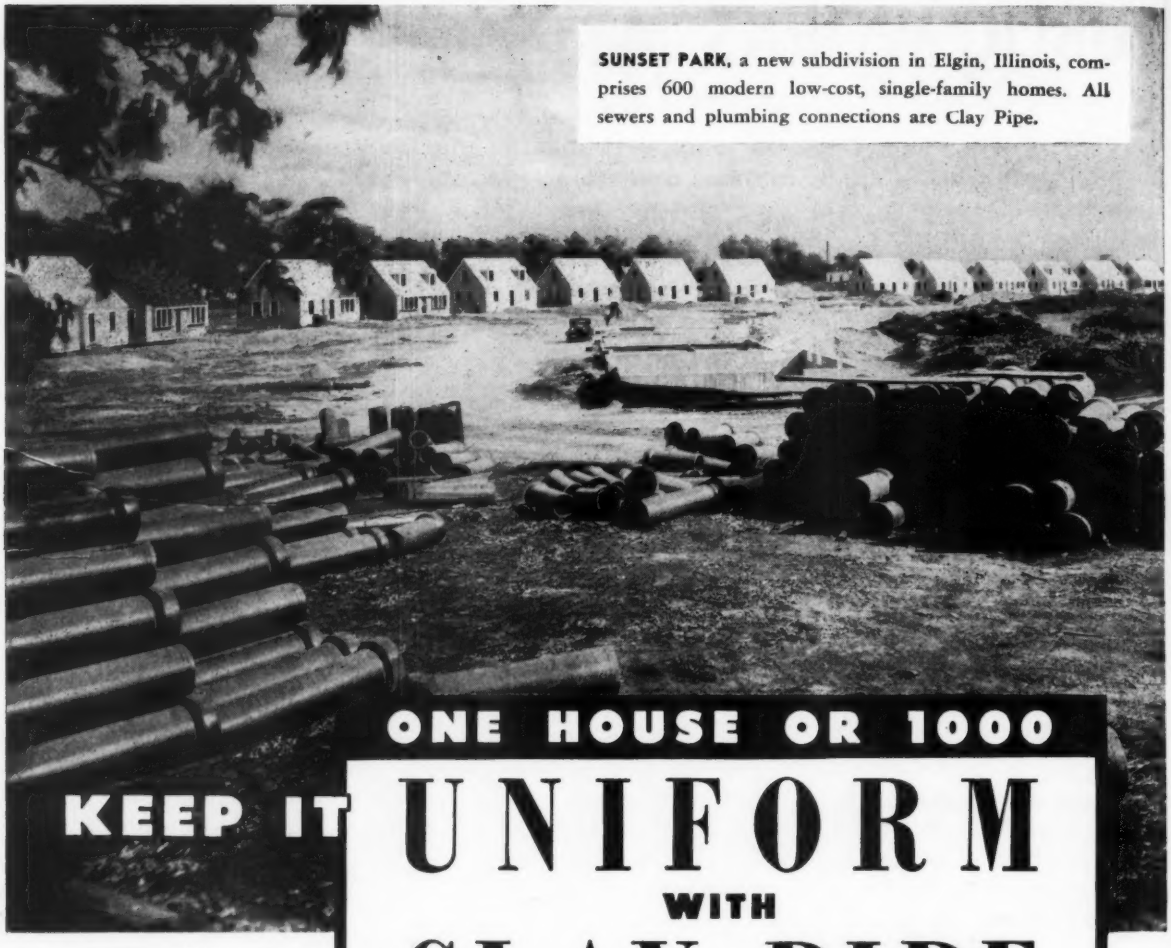

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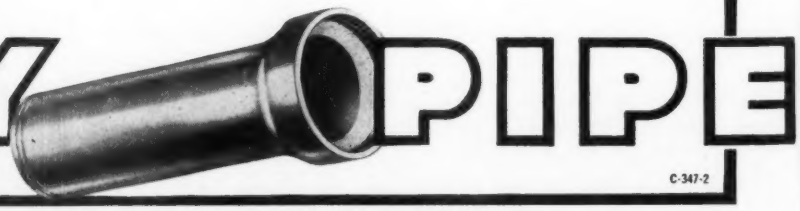

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The Editor's Page

Highway Investments and Highway Engineering Pay

This country has something like thirty billion dollars invested in its highway system, and it spends upward of a billion and a half each year for construction and maintenance. Certainly a business of such scope should pay some very fair salaries. Well, according to reliable authorities, the top salary paid to any state highway engineer is $15,000; the median salary for all state highway engineers is $6,350; and we won't speak about the lowest. These salaries are for the top men in each state and they bear no relationship to responsibility, mileage, the size of the budget, or the other factors that should influence pay. Resident and project engineers vary from $1,620 to $4,800; starting salaries vary from $900 to $2,100. In other words most of these engineers get less than the average government clerk. There is very little incentive for a young engineer of ability to enter a state highway department.

We understand the difficulties that so often prevent the correction of these injustices, or appear to prevent them. There is no easy way of correction, but we would like to suggest that the various state engineering societies appoint committees, if they have not already done so, to study the salary scales for engineers in state service, and to carry promptly to the legislature the results of their findings, along with fair recommendations for revised pay scales.

Engineer Registration and Society Membership

Every engineer ought to obtain a license to practice engineering, whether he is required by law to obtain it or not. And he should also become a member of one or more of the overall appropriate engineering societies.

The time has come when this is most desirable, if not actually necessary. More and more, broad problems involving engineers and engineering are arising, which can not be handled by individuals. Strong, well-organized societies composed of engineers, and directed by engineers, are needed to represent the profession and to see to it that engineers receive fair and just treatment.

Our engineering societies are doing a very good job; if they represented more engineers, they could do a better job.

Building Better Equipment for Public Works

One of the many contributions to better roadbuilding that has been made by the Highway Research Board and the American Roadbuilders' Association, is the get-together of highway engineers, highway contractors, and highway equipment manufacturers. At these meetings, the highway engineers tell what they would like to have, and the manufacturers either get a lot of good ideas or tell the engineers why it can't be done. At a recent meeting at which were discussed pressure distributors, aggregate spreaders, mixed-in-place equipment, plant-mix equipment, bituminous finishers and rollers, all three groups agreed that these frank discussions were mutually helpful and tend to acquaint each group with the needs and problems of the others. Furthermore, they stimulate the development and proper use of mechanical equipment.

This is an idea that ought to be carried farther and into other fields. Engineers engaged in water and sewerage design, and the men who operate the plants, ought to have ideas that would be interesting to manufacturers of equipment for this field; and the same applies to refuse collection and disposal, and many other public works activities.

Making Three-Lane Roads More Useful

A good portion of a 3-lane road, especially in rolling country, is only a 2-lane road, though the taxpayer pays for 3 lanes. On every curve and on every hill the only function of the third lane is to carry a "no passing" stripe. Construction of a fourth lane on such areas would accomplish at least two very useful purposes. It would greatly increase traffic capacity, as everyone knows who has crawled up a long hill behind a heavy truck; and it would greatly increase safety. Patience is not a virtue with most of us; too many of us, even highway design engineers, take a chance when we are in a hurry. The grade crossing elimination program of some years ago returned big dividends in reduced grade crossing accidents. There is no reason to believe that a "4-lane on hills and curves" program would not accomplish as much.

Santa Claus for the Army?

On the basis that doctors are hard to get into the Army, the War Department has introduced into Congress a bill that is irreverently, perhaps, known as the "Santa Claus bill." It provides $100 a month extra pay for doctors, for not over 30 years, as a compensation for the time and expense of securing a medical education. This tidy sum of $36,000 should really provide a broader and sounder education than doctors have had in the past; but since it is retroactive, the immediate effect will be small, no doubt.

This bill is typical of the shallow thinking that pervades some of our higher circles, and of the desire to go ahead on a scarehead basis without any study of the broader needs of the Army, or consideration of other professional men that the Army needs just as much as it needs doctors. Also, looking at it from another angle, we might conclude that engineers have been pretty much asleep at the switch, both in proposing legislation for the benefit of engineers, and in opposing that which is to their disadvantage. Opposition to a number of bills adversely affecting engineers has been unorganized, and mostly carried on by individuals. It is time that this was changed; and we hope that the newly organized committees of the NSPE and the ASCE on military affairs will be functioning both offensively and defensively before Congress meets again. In the meantime, if the Lord remains on the side of the weak, some of the bills we have complained about in these columns may be delayed enough not to pass at this session.

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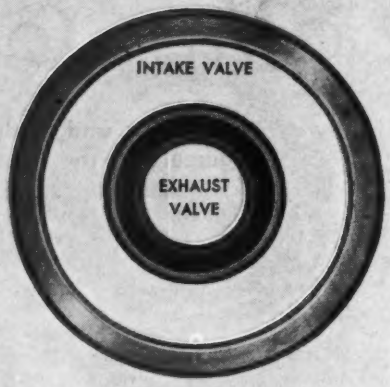
P & P-115



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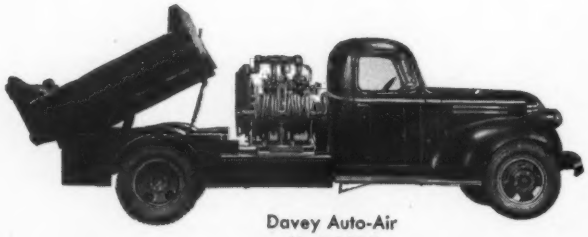

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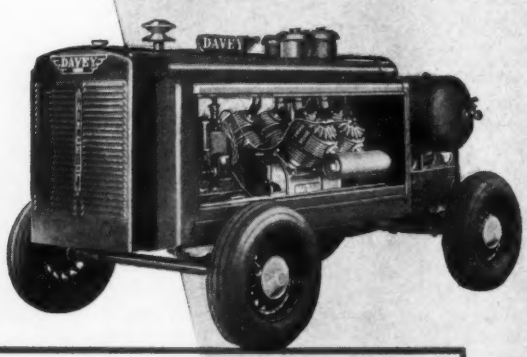

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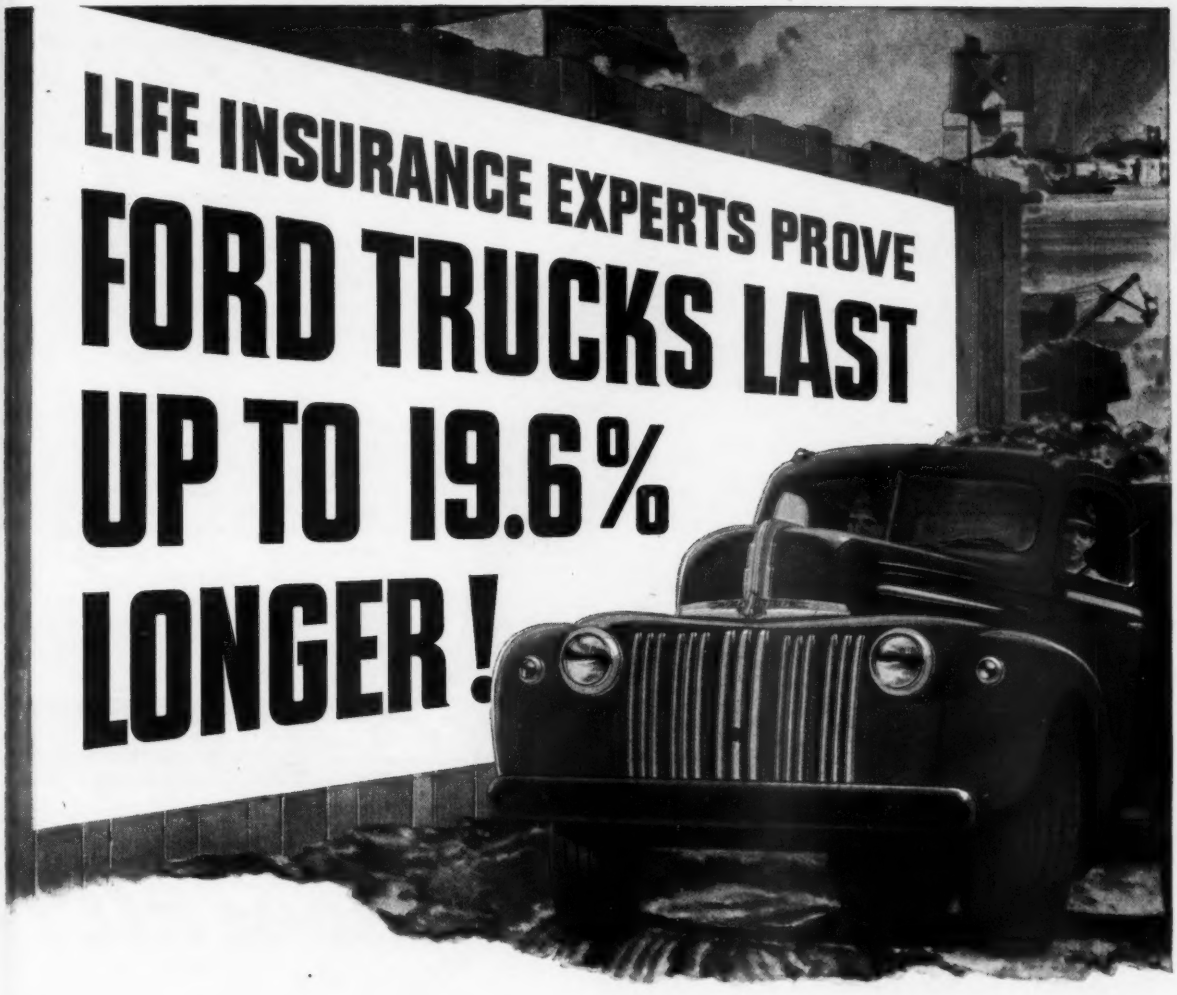

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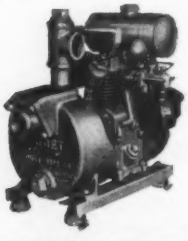

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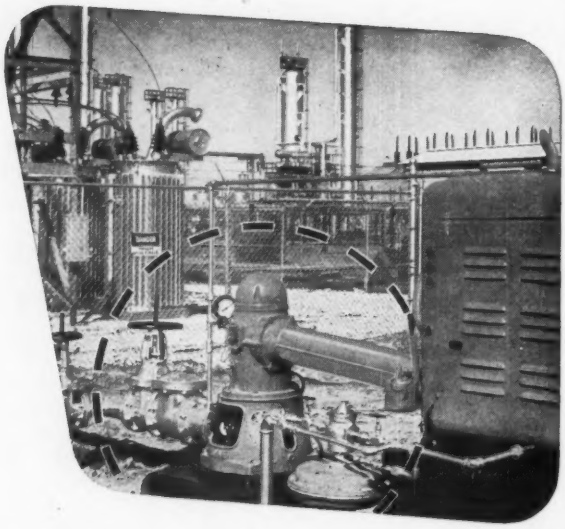

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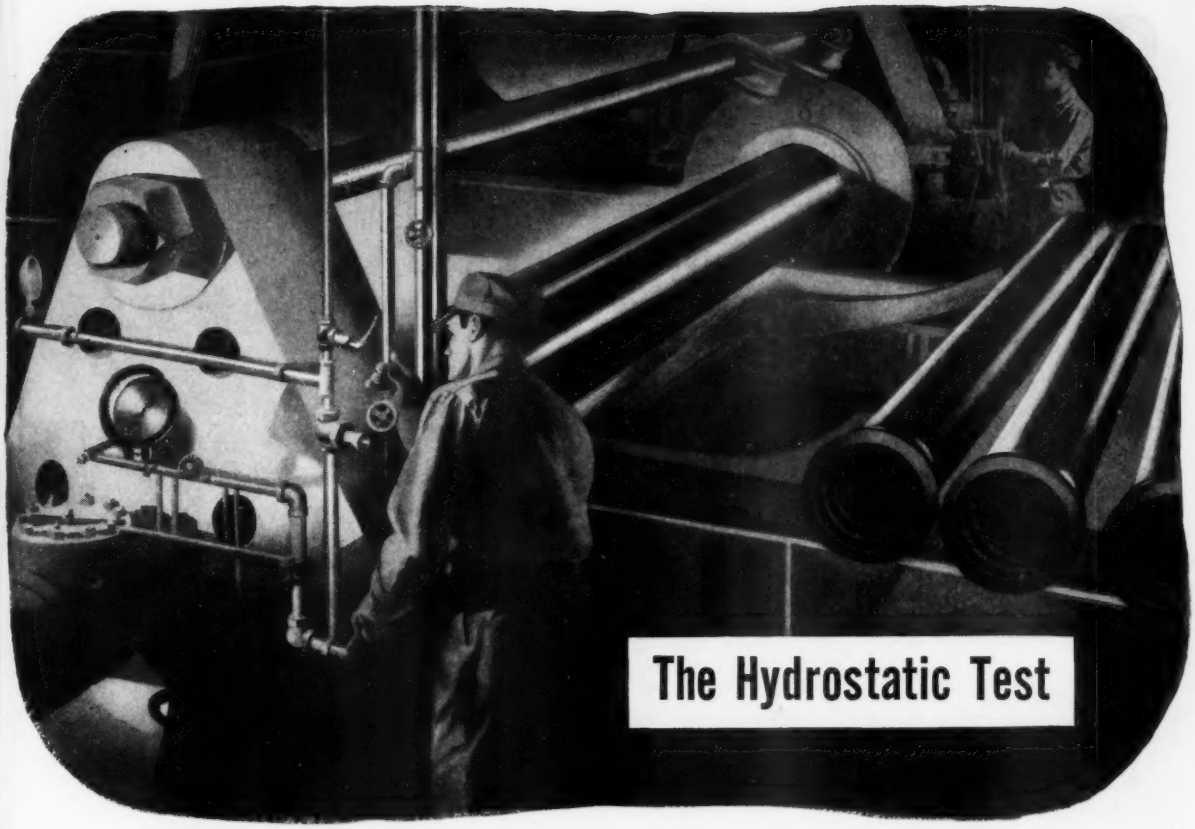

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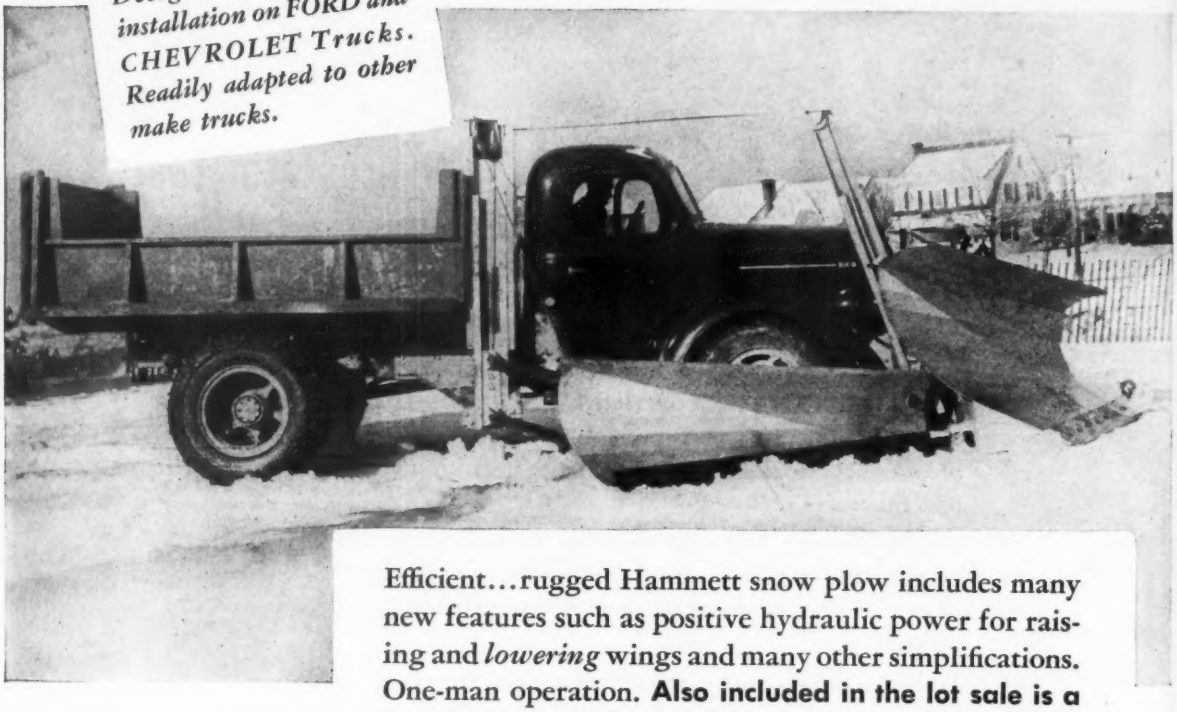

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PUBLIC WORKS MAGAZINE . . . August, 1947

VOL. 78. NO. 8

Truck of city of Syracuse ready to start spreading salt

Syracuse Saves Money on Snow and Ice Removal and Reduces Accidents

By C. EDWARD BILLION
Commissioner of Public Works, Syracuse, New York

LAST winter Syracuse saved approximately $1,700 on snow and ice removal costs when one of the severest winter storms in many years hit this section of the country. At the same time the Public Works Department speeded up snow and ice removal operations and gave local motorists streets that were safe for driving within a short time after each storm ended. Although winter is still a few months off, the department is already making plans to do it again this winter.

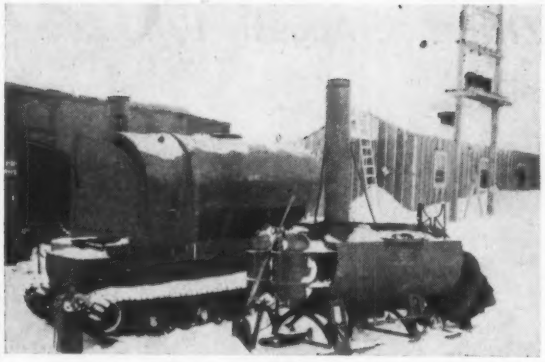
Syracuse is a hilly city, and many of these hills are so steep that cobblestones and brick have been set into the center to provide traction on the grades. Since cobblestones and brick freeze quicker than any other type of pavement, we have to be particularly careful that no thin films of ice form on them, for they can spell sudden death to skidding motorists and serious accidents to pedestrians. A light snowfall or a freezing rain is worse than a blizzard in some respects, because they may form a slick coating that catches motorists unaware.

Then, too, we have rapid variations in temperature to contend with. Frequently the temperature rises high enough during the day to thaw the snow and then drops again to freezing by night. We have to time our activities carefully to take advantage of such changes. Since we are in a better position to help reduce traffic accidents than any other city department, we do everything possible to get streets completely free of snow and ice before morning traffic starts.

From the Weather Bureau we usually get 24 hours notice on the type of storm shaping up, and by the time snow or sleet begins to fall we have our trucks loaded with rock salt and the department's mechnical salt spreaders hooked up and ready to go. These are sent out before traffic can get on the snow and pack it into sheets of ice. When possible our practice is to put

(Continued on page 20)

Applying salt to the streets.



Left, experimental 50-gph ice and snow melter under test at Ft. Churchill. Right, the winter supply of water piled up at the cabin door.

Water Supply Problems of the Arctic

Methods of procuring water in areas where temperatures are 40 or more degrees below zero. Protecting pipe lines against freezing. Supplies for smaller installations.

By A. B. CRONKWRIGHT

MILITARY operations in the Arctic area in the past war were dependent primarily upon the availability of adequate means of transportation. The larger installations, requiring all year accessibility, had to be located close to the sea coast for supply by boat during the summer, and to an adequate air strip to permit emergency supplies of equipment and personnel during the winter months. These prime considerations oftimes left no choice of locations as far as suitability of the site with respect to a good water supply.

The Arctic area during the summer months presents no problem with regards to availability of good water. As anyone that has flown over the Arctic tundra during the summer can testify, there is seemingly more water than land. Landlocked lakes and ponds dot the entire Arctic area. Small streams turn into good sized rivers. The quality of the water in these lakes and streams is usually excellent. Contaminating influences are at a minimum. Deciduous vegetation is absent and clear sandy bottoms are the rule rather than the exception. High mineral content, however, may cause some of these sources of supply to be regarded with disfavor.

Winter Is Something Else Again

Winter conditions, however, are something else again. Temperatures below —40°F., for weeks at a stretch, freeze the landlocked lakes and ponds solid unless they are of a fairly good depth. Streams dry up or freeze to the very bottom. All year supplies are relatively few, and because of the terrain, sometimes inaccessible. An instance in point was the supply for an Army air base on Baffin Island. The source of water for this installation was from a river located about two miles from the base proper. A road had been blasted out of the rock terrain so that tank trucks could transport the necessary supply to the various buildings. Storage consisted of a 25,000-gallon wood stave tank in the hospital unit, a 1,000-gallon tank in the mess hall, a 2,000-gallon tank in the camp laundry and a 100- to 200-gallon tank in each barracks.

Sterilization of the water was accomplished by placing a specified amount of HTH in each tank truck while filling. Adequate retention time was secured before the truck returned to the base and the base surgeon occasionally checked the trucks at different locations to determine the presence of a residual. This means of supply proved very satisfactory except for certain unavoidable difficulties that had not been entirely anticipated. First, the occurrence of Arctic blizzards choked the road so that the smaller 6-wheel tank trucks could not get to the river despite attempts with bulldozers to keep the road clear. The only truck able to maintain even a sporadic supply proved to be a 10-wheeler that had a tank lined with a bitumastic compound having a high phenol content. The chlorine, which heretofore had not been noticed by the camp personnel, now made the water unfit even for making coffee. Because of a lack of knowledge on the part of the base personnel as to the cause of their predicament and because of the base surgeon's strict observance of Army regulations, the entire base suffered for almost two weeks.

Secondly, during the course of several storms, even the heavy tank truck was unable to get to the river for several days at a time. Even by running the bulldozers continuously the road could not be kept clear. Drifts were 10 feet and more in places and when cut through would fill in within a half hour. The snow was like a fine sand driven at high velocity and long exposure was dangerous. Water was strictly rationed during these times and a reserve of 10,000 gallons was maintained in the hospital tank for fire protection. Washing was suspended and water was used for cooking and drinking only.

The River Freezes Solid

Thirdly, about the first week in March the river, which during the summer is a quarter of a mile wide and from 10 to 20 feet deep (and, incidentally, is a wonderful fishing stream) froze practically solid. This necessitated blasting and clearing in mid-winter a road

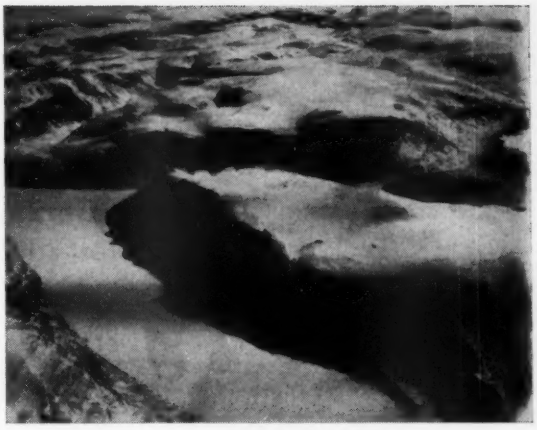
to a lake about 4 miles from the camp. The freezing of the river did not come without warning, but even so, the time allotted was limited and the job was no small engineering feat. The terrain was definitely rugged. Snowdrifts were encountered that were 40 feet and more in depth. Hills over 400 feet in elevation and of steep slope had to be crossed. Bulldozers hauling tanks mounted on sleds or on caterpillar treads were required to make the trip. Hauling was pitifully slow and the supply was very inadequate. The quality of the water from the lake was not good, being highly mineralized and having a high color.

A snow melting machine was set up but proved most impractical in that the amount of water secured was very small and the machine proved most expensive to operate in view of the large amount of fuel oil required to convert snow to water. Since oil is a very precious commodity that requires constant conservation, its use for this purpose is not desirable unless absolutely essential.

Solutions to the above problems may be found in the construction of newer types of snow vehicles capable of traveling over rugged terrain and through high drifts in all types of weather and visibility. Some of the new types of drilling equipment may enable rapid search for underground sources of water that would give a supply of water closer to the established installation and would be less likely to be influenced by continued cold weather. Permanent frost extends below 100 feet in this particular locality and frozen rock is not easy to drill. The suitability of the high speed rock drills now available for work in this field ought well be investigated.

Water Distribution by Pipe Line

The distribution of water by pipe line in the Arctic for not too long distances is not only possible but is economically feasible despite abnormally low temperatures. This can be accomplished by placing the distribution mains on the surface of the ground, encased in a well insulated box that is supplied with a means of heat. One such installation was constructed in a sub-Arctic area where temperatures of from —40°F. to —50°F. were recorded for periods of a month at a stretch. The particular installation consisted of a made reservoir of about 30 feet in depth constructed by placing a small dam across a stream conveniently located at the edge of the camp area. The water was swamp water, highly colored and having an iron content of 8 to 10 ppm. A very suitable treatment plant was installed consisting of a pre-chlorinator, alum and soda ash feeders, reaction tank, two sand pressure filters in parallel and a larger carbon pressure filter in series with the sand filters. The water was stored in a 25,000-gallon wood stave tank and was pumped directly into the distribution system. A meter controlled hypochlorinator permitted post-chlorination. Good operation, however, was lacking.



Oblique aerial view of Baffin Island terrain.

The distribution system consisted of a 6″ distribution main running from the treatment plant, on the surface of the ground; first, over the stream which was the reservoir overflow, by bridge; then to a civilian mess hall; to the camp laundry; to a softening plant; to a steam plant and power house; to the base hospital installation; and finally to the officers' mess hall. The distance traversed was, all told, about 2,500 feet of which about 750 feet was enclosed within the hospital corridor, the balance being outside.

Protecting the Pipe from Freezing

To protect the pipe from freezing, the following procedure was followed: First, it was encased in a wood box approximately 36″ by 18″. Packed around the pipe itself was Kimsul, completely filling the box. As an added protection a 3″ steam line and a 1″ return was placed in the box alongside of the 6″ main. This ran from the steam plant to the civilian mess which was the first takeoff on the main. The steam was used to heat the building and also was used in a heat exchanger to furnish hot water. The water in turn was used in the mess and in addition a 1″ hot water line was run alongside of the 6″ main back to the treat-

Roadway along ice-covered river. Oil drums were used as flare route markers in stormy weather.

ment plant. At the plant it was tied into the 6″ main by means of a small recirculation pump. This permitted the hot water to recirculate back to the civilian mess hall.

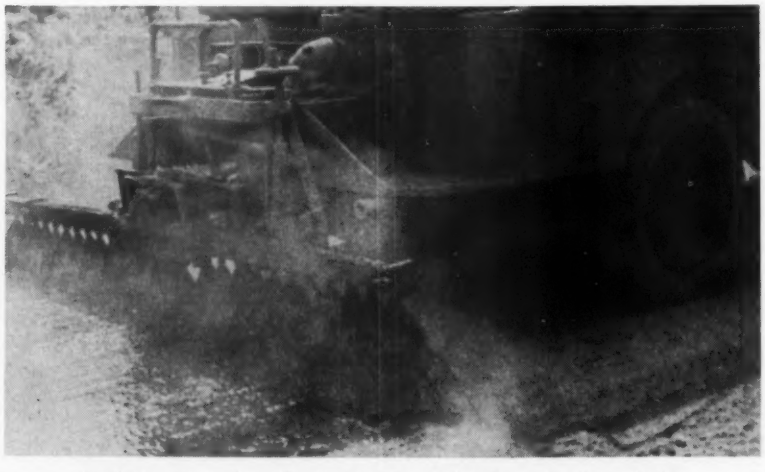
In the other direction from the steam plant there was a 6″ steam line and a 4″ return laid adjacent to the 6″ main. This continued beneath the corridor floors throughout the hospital with branches being taken off at each intersecting corridor. At the other end of the hospital the Kimsul lined wood box continued to the officers' mess. Here again a 3″ steam line and a 1″ return was placed in the box as a source of heat.

All in all it was a beautifully installed and conceived set up. The writer was at this base when the outside temperature hovered for days at —41°F. The cold water, as received at the laundry with —41°F. outside, was 106°F. at the start of operations in the morning. At various points throughout the hospital the temperature of the water was increased to 120°F. At the officers' mess at the end of the line the temperature had dropped to 102°F. By opening valves and wasting water the temperature could be brought down to 86°F. but not below: this, in spite of the fact that the initial temperature of the water at the treatment plant was between 32°F. and 33°F.

There was very little heat loss through the Kimsul as was noted by the absence of any melting snow on the box. It was an excellent layout except for being a bit overdesigned. Undoubtedly, a smaller box would be more than ample and a little less heat would prove more satisfactory. Another point to mention with respect to this installation might be the fact that one end of the box caught fire through some unknown cause and burned out about 75 to 100 feet of insulating material before being brought under control. Fighting fire in the Arctic in winter is not very successfully accomplished as has been shown at most every installation built by the Army in that area during this last war. It would appear most logical, therefore, to install fireproof insulation as much as possible. Fireproof material is not only as effective as other types but may be more readily available.

Location Data for Smaller Installations

The preceding has dealt with larger installations where the site is predetermined by considerations other than the availability of an adequate water supply. For smaller installations, weather stations, outposts and temporary camps of small size, the location can be so laid out that the supplying of water will be an easy matter. Location near a reasonably deep lake is obviously the most desirable since there is not the tendency to freeze solid that there is with a stream. Holes cut through the ice daily permit water to be secured by pumping or by buckets. Very little trouble was experienced at these installations, one reason probably being that the smaller outposts were supplied with an over abundancy of fuel oil that could be utilized to melt snow gotten just outside or in some instances just inside the door when weather conditions did not appear too favorable.



Huntington Co., Ind., applies Texaco SC asphalt prime coat prior to laying mixed-in-place asphalt.

Snow and Ice Control in Syracuse

(Continued from page 17)

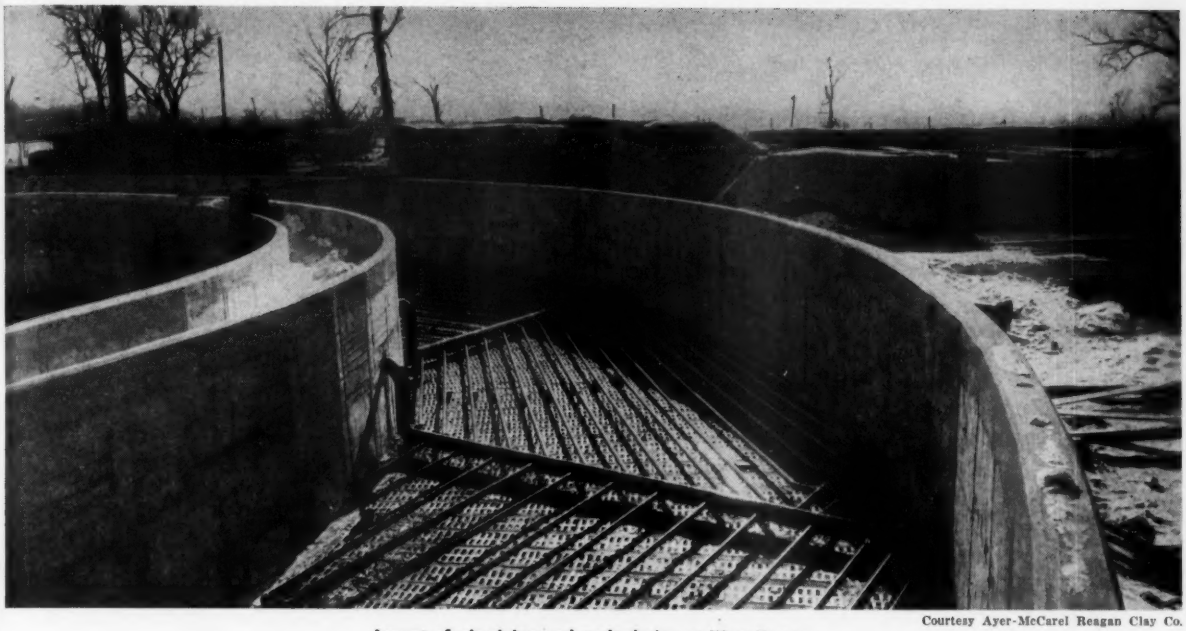
salt on streets in the downtown section between 3 and 4 in the morning. Then, by the time the sun comes out, the rock salt crystals have bored down through the snow or ice and undercut them. The sun continues the melting process, and if any snow remains when the plows come through they simply push the salted snow against the curb for later hauling by trucks. Salt prevents hardening even if there should be some delay in removing snow. In a really bad blizzard accompanied by freezing rain we repeat the salt treatment after each plowing.

After servicing the business section the rock salt trucks and spreaders move on to all arterial highways, stop streets and secondary hills. We once tried sand for traction on our steep grades but we found that the sand tended to blow off into the sidewalks before it could become embedded in the snow so we switched to a rock salt and cinder mixture for these areas.

We now have 27 routes that take about 2½ hours each to cover. At present we are working on a plan to add more routes this winter and speed the work still more. The department's trucks, 6 mechanical rock salt spreaders and 32 plows are augmented by outside trucks which we hire to expedite removal and snow control in a continuing storm. All private operators are assigned in advance to certain routes, and as the need for this additional equipment arises, each man is notified to check in at one of our garages. He picks up a load of rock salt and goes on to take care of his area.

We plow the entire city, which consists of 240 miles of paved streets and 154 miles of dirt streets, and we salt from 50 to 60 miles of streets and roads every time it snows. As an extra service we supply St. Joseph's Hospital with salt for their steps as an emergency measure and have salt boxes at all underpasses. Last year police department records showed that there were fewer accidents than before at salt-treated intersections, and now all intersections get rock salt immediately.

Our saving in labor and hauling charges results from the fact that rock salt will melt up to 4 inches of snow. We also save by eliminating the need for cleaning sand and cinders out of catch basins and culverts in the spring.



Courtesy Ayer-McCarel Reagan Clay Co.

Layout of air piping and underdrains at West Fargo.

Backwashing for a Trickling Filter Installation

Information on the design of a unique installation to handle a strong packing-house waste, with a summary of operating results when used as a 2-stage and as a 3-stage filter.

TO TREAT a packing house waste containing about 1,500 ppm of BOD, an unusual filter was designed and constructed some seven years ago. A brief description of the plant and a summary of the operating results were contained in a recent personal communication to the Editor of PUBLIC WORKS by L. R. Howson, of Alvord, Burdick & Howson, consulting engineers. This installation at West Fargo, N. D., is a three-stage trickling filter, but it may be operated as either two-stage or three-stage.

The grit and flocculating tank has a retention period of about 30 minutes. At the inlet end of the flocculating basin, a grease flotation chamber is provided to which air is admitted through perforated pipes. The primary settling tank provides about 30 minutes' retention. From this tank, the sewage passes to a water works type rate controller which is set for the average daily rate of flow. Surplus flow goes to a storage tank, accumulating there during periods of heavy flow and being drawn off again during period of sub-average flow. This tank has a capacity of about 20% of the average daily flow.

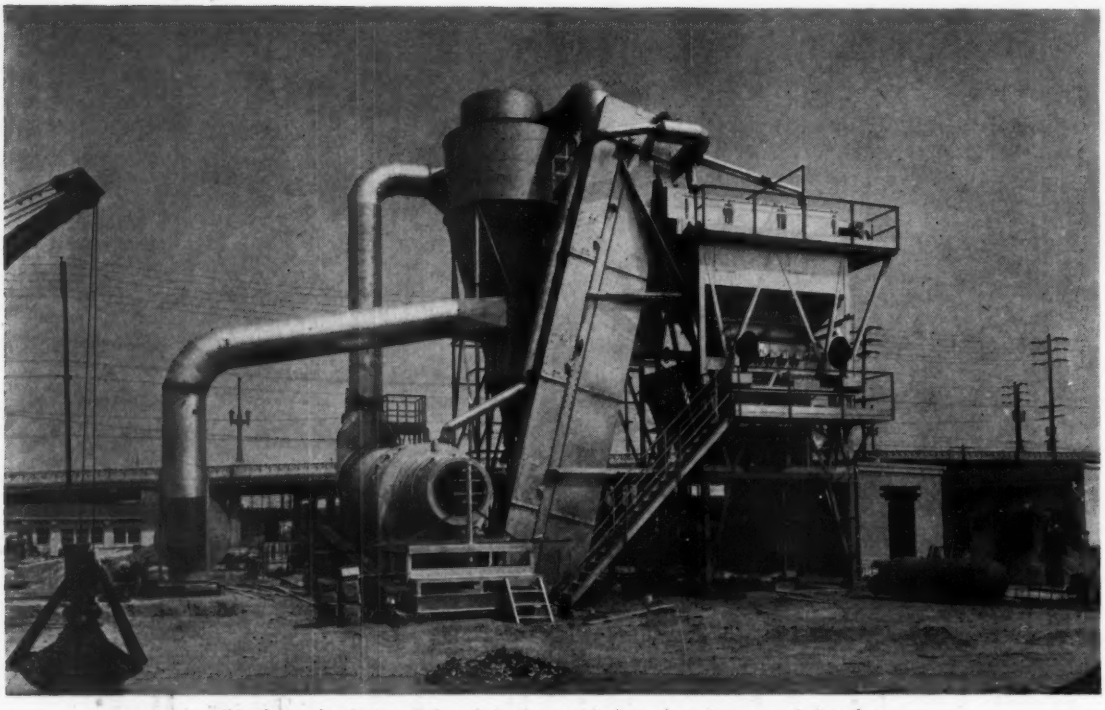
There are four primary filters, each 42 ft. in diameter and 6 ft. deep, the media ranging from 1 to 2 ins. These primary filters are dosed at the rate of 5,000 to 8,000 lbs. of BOD per acre-foot per day. On account of the grease content of the waste the filters are provided with air and water wash. Air for backwashing is admitted through a pipe grillage system consisting of 1½" pipe laid at 18" centers with ¼" orifices set in the bottom at 18" spacing; 2,000 cu. ft. of free air per minute is available for washing, the equivalent of approximately 1½ cu. ft. per minute per square foot of filter area being washed.

Water for backwashing the filters is available from a wash water tank designed to deliver 5,000 gallons per minute, the equivalent of 4 gallons per square foot per minute of filter being washed. In practice the filters are backwashed about once in three weeks. The dirty filter wash water is returned to the incoming sewage.

Air is introduced into the bottom of the primary filter only during the backwashing period. Observations within the filter indicate a jelly-like growth throughout the entire 6 ft. of depth. The whole filter is active; and it picks up its operating efficiency almost immediately after washing.

The primary filters, including intermediate settling, reduce the BOD of the raw sewage from 70% to 80%. This effluent is settled and then passed through two filters of the standard-rate type, each 6 ft. in depth. When operated in parallel, the effluent carries from 30 to 50 ppm BOD. When operated in series, resulting BOD is from 10 to 30 ppm. With three-stage operation the final effluent carries from 10 to 20 ppm of nitrates, 5 to 6 ppm of dissolved oxygen, is stable, and has kept the stream in fine condition for the 7 or 8 years in which the plant has been operated. The effluent, as will be noted, indicates a BOD reduction of 98% to 99% through the plant.

The high operating efficiency is maintained throughout the cold winter months. This is due in part to the fact that the packing house waste has a temperature in excess of 70° the year around.



This shows the dustproofed asphalt plant, with dryer, hot elevator and dust duct.

Los Angeles Builds a New Asphalt Plant

Ultra-modern, $325,000 plant has electric heating, hydraulic controls and many new features.

IT IS not difficult to visualize the many road building problems of a city which sprawls over an area of 465 square miles and has 4,828 miles of streets. It is enough to say that the Street Maintenance Department of the City of Los Angeles has one of the biggest street repair jobs in the world and one that goes on all the time. Some 2,358 miles of the city's streets are asphaltic concrete or plant mixed rock and oil. The maintenance of these streets normally requires the operation of three mixing plants having a total batch capacity of 9,000 pounds. As a consequence, the city found itself with a real problem when the largest of its plants wore out shortly before the war.

To replace this unit plans for a modern, dustless 4,000 pound installation were started immediately but war-time material priorities kept the new plant on the drawing board until 1945. Work to clear the site finally was started in December, 1945, and completion of the job is expected this summer.

The new installation, built at an approximate cost of $325,000, is located on a two-acre site at 2484 E. Olympic Blvd., near central Los Angeles. In addition to the new black top batching plant, facilities include garage space for twenty 10-ton dump trucks, a shop, showers and lockers, living quarters for the caretaker, switch house, compressor house, and a modern office and scale. It is the only plant in the country as far as known by city officials, where the heating of all materials (except for the flame dried aggregates) is done electrically and a steam boiler is not used for any purpose.

Specifications for the entire plant were prepared under the supervision of H. P. Cortelyou, Engineer Director of the Maintenance and Sanitation Department, and L. Miller, General Superintendent of the Street Maintenance Division. F. Sandusky, Superintendent of Asphalt Plants and Transportation, was in direct charge of construction. Louis Graham, Electrical Foreman for the city, designed and supervised the installation of all electrical equipment. H. E. Norell is foreman of the new plant.

The largest single contract in the project covered the construction of the asphalt plant proper. This was awarded to the Standard Steel Corporation of Los Angeles. The plant was fabricated in integral units at Standard's shops, shop-assembled, shipped, and erected on the site under their supervision. The illustration above shows the plant under construction.

The new plant will enable the city to manufacture its own paving materials and will allow complete control over the quality of the material produced. This is especially important because of the variety of mixes

used—some seven different types may be required of the one mixer in a day's operation.

Although the new plant is capable of mixing 1,350 tons of material per 9-hour day, production will be limited according to the income anticipated by the department during the fiscal year 1947-48. This sum, proportioned over the year, will call for a daily production of 894 tons or 205,620 tons in the year. The city's two other plants located in the San Fernando Valley will produce 214,130 tons. This totals 419,750 tons of material which will be used on the streets of Los Angeles in the fiscal year 1947-48 for street maintenance only.

The aggregate bunkers for feeding the plant extend to approximately 11 feet below ground level and have a capacity of 1,000 tons of material. Constructed of reinforced concrete, they are 28'4" wide and 153' long. Seven different compartments are provided as follows: 1½" stone; ¾" stone; ¼" stone; pea gravel; rejects; sand; and crusher waste. All bins are equipped with grizzlies.

A steel canopy for weather protection will be built over the entire length of the bunkers with only the ends enclosed. This permits incoming trucks to dump and drive straight through.

Conveying System

The belt conveying system is contained in a concrete tunnel, 7' high x 8' wide immediately below the bunkers. The main belt is 26½" above the floor of the tunnel, 304' long x 24" wide and is carried on 38 sets of flat roll idlers 5" in diameter. Power is provided by a 5 hp., 30 rpm., synchrogear motor. Six 24" feeder belts on 5' centers are installed under the bins for sand and crusher waste.

The material desired for a particular batch is roughly proportioned as it is dropped on the belt and carried to the cold elevator pit. This control over the flow of material into the plant is highly important to the maintenance of peak efficiency throughout the working day. By not allowing an excessive amount of material to reach the cold elevator, the aggregates are thoroughly dried, the screens are not overloaded, carryovers are held to the minimum, and the hot aggregate storage bins are maintained at their proper working levels at all times. The aggregates are conveyed from the pit by a 39' elevator driven by a 20-hp. geared-head electric motor direct-connected to the elevator head shaft. This delivers 150 tons of aggregate to the dryer per hour.

The firebox is shaped like a cone, 4'6" in diameter at the fire end and 5'6" in diameter at the outlet end. In order to obtain a quicker and more efficient combustion of the gases, it was made 10 feet long. Since fireboxes usually tend to burn out at the top, four trunnions permit the entire assembly to be rotated so that top wear is evenly distributed. The interior of the firebox chamber is lined with a six inch layer of Plibrico, a type of firebox material that can be applied like wet cement and does not completely set until the firebox is put to work.

The burner is a Bunsen type, using eight nozzles when firing with natural gas. When firing with fuel oil, air from a 360-cu. ft. compressor is used to atomize the fuel. Separate control valves are provided for each gas burner as well as one master control. With gas having a BTU content of 1,050 and a nozzle pressure of 20 PSI, the burner can raise aggregates having a 10% moisture content to a temperature of 325°F. and can dry 150 tons of material per hour. After being dried, the aggregates are discharged from the dryer into the boot of the hot elevator which conveys them 42' to the vibrating screens at the top of the plant proper.

Vibrating Screen and Hot Storage Bin

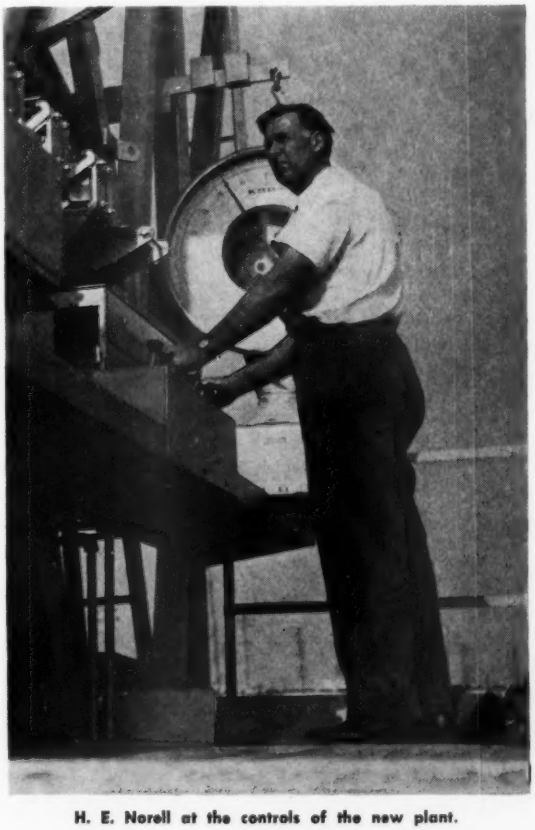
The plant is equipped with a Symons 48" x 14' double deck vibrating screen. A 15-hp. 1,800 rpm. motor is mounted on the screen base frame and transmits power to the eccentric head with V-belts. Isolation spring mountings which absorb the vibration of the base, support the screen at each corner. The unit is equipped with four sizes of steel wire screens as follows:

Material	*Screen Size*	*Wire Size*
Sand	4' x 8½'	16 gauge
¼" Rock	4' x 9'	12 gauge
½" Rock	4' x 5'	8 gauge
¾" Rock	4' x 5'	4 gauge

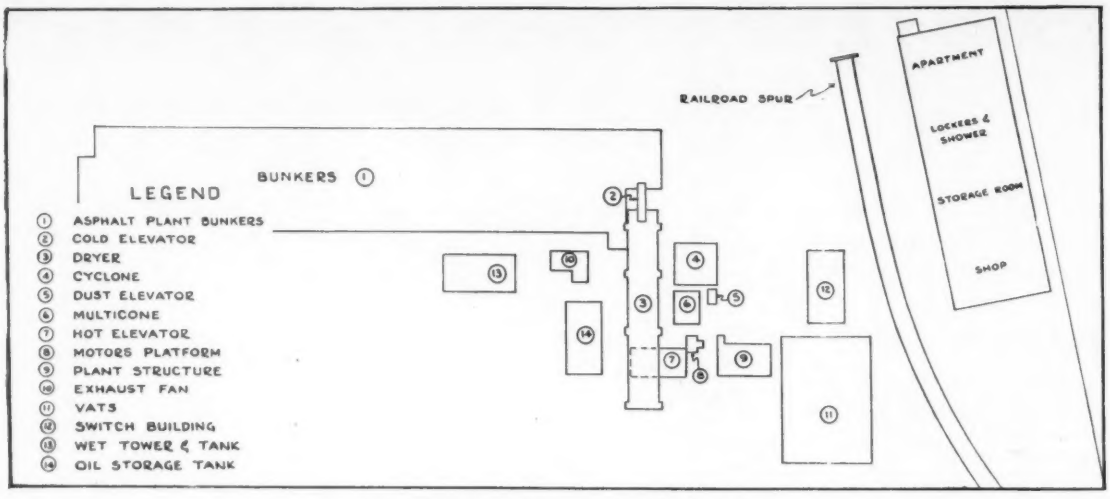
The storage bin for the hot aggregates, which is located directly below the screen, has a total capacity of 25 tons. It is divided into four compartments to provide space for 6¼ tons each of sand and ¼" rock; 5 tons of ½" to ⅝" rock; and 7½ tons of ¾" to 1" rock. The bins are made of welded ¼" steel plate with built-in access doors. The outlets from each bin compartment to the weigh box are equipped with gates operated by Vickers hydrauic units.

A 6-ton overflow bin is mounted on the side of the mixer plant. Any spillage from the four storage bins is carried to this bin in a completely enclosed chute. The discharge gate for the bin is positioned at the same level as the mixer discharge gate so that the overflow material may be easily removed by truck.

The weigh box is carried on a 4-point suspension



H. E. Norell at the controls of the new plant.



General layout of the Los Angeles asphalt plant.

mounting, the tapered portion being linked with ¼" steel plates. As the materials drop into the box from the hot-storage bins immediately above it, they are weighed by a Kron springless scale having a 30" dial and a capacity of 5,000 pounds. Rigid supports are used in the structure which carries the scale and scale levers to reduce any vibration of the scale needle to the minimum. The weigh box and mixer are completely enclosed in a dustproof housing. Entries are provided to inspect or sample the aggregates.

Mixer Details

The pugmill mixer has a net working capacity of 4,000 pounds per batch and is powered with a 100-hp. 600 rpm. motor. Mixing is accomplished with two parallel shafts, each equipped with 16 paddles, rotating in opposite directions. Although the city plans to operate on a 45-second cycle, a very thorough mix can be accomplished in 30 seconds. An hydraulically operated slide-gate allows a 4,000-pound batch to be discharged in six seconds which includes the time necessary to open and close the gates.

The 400-pound asphalt weigh bucket has a conical bottom with an 8" diameter outlet valve and can be emptied in 10 seconds. Its discharge, direct by gravity into the fan chute, is controlled by an hydraulically operated valve. Both the valve and the bucket bottom are electrically heated which enables a free flow of asphalt and easy operation of the valve at all times. Hydraulic controls are also provided for the two 3-way valves which control the flow of asphalt into the weigh bucket. A 500-pound capacity Kron scale with a 30" dial is provided to measure accurately the asphalt charge for each batch.

Dust Collecting System

In order to be absolutely certain of complete dust control, Los Angeles specified the use of both a cyclone and a multiclone in conjunction with a spray chamber and settling tank. It is estimated that the cyclone will remove 75% of the solids, the multiclone another 15%, and the spray chamber 9.9% for a total efficiency of 99.9%. The system is designed to handle 30,000 cubic feet per minute of combustion gases and dust laden air when adjusted to a temperature of 350°F. and atmospheric pressure. Housings and ducts are provided to withdraw gases and dust from the dryer inlet, the dryer outlet, the top of the hot elevator, the weigh box and mixer, and the vibrating screen. The duct from the dryer inlet has a diameter of 42" while all others are 10" in diameter.

The cyclone is of conventional design, 14 feet in diameter. Dust laden gases pass through it and then enter the multiclone for further precipitation. The multiclone which contains 54 tubes, 9" in diameter, was made by the Western Precipitation Corp. Gases leaving the unit are picked up by a Sturdevant #80 planovane exhauster fan through a 42" duct and driven to the spray chamber and settling tank for final and complete precipitation of the solids. The use of both a cyclone and multiclone required a 100 hp. motor instead of the usual 50 to 60 hp. motor.

The spray chamber is 10′ x 10′ x 40′ high. Dust laden water from the chamber flows into a concrete settling tank 10′ x 20′ x 5′ high. Water which is cleaned in a settling tank is picked up by a pump and recirculated through the wet house sprays. The dust removed from the gases by the cyclone and multiclone feed is discharged to an enclosed elevator powered by a 5 hp. geared-head direct-connected motor. A chute at the top of the elevator carries the dust to a 3-ton storage bin. From here it is conveyed direct to the aggregate weigh box by a fully enclosed helical screw. A fifth weighing unit which might be desired for a particular mix is thus provided.

This system varies from the usual practice of conveying the dust back to the boot of the hot elevator from where it eventually enters the sand bin. It is felt that this method is superior in that it gives a better control over the fines which enter the mix. This in turn can effect a definite saving in the amount of asphalt needed since the presence of an excessive amount of fines requires additional asphalt for a proper mix.

Asphalt and Oil Storage

There are two reinforced concrete asphalt storage tanks with a capacity of 100 tons each. These are completely below ground. Each is 10′ wide, 10′3" deep, and 35′ long; a common concrete wall running lengthwise separates the two. The tanks hold more than four tank cars of asphalt which is brought to the plant on a spur railroad track. While the asphalt is stored in the tanks, it is held at a temperature of 250 to 300 degrees by thermostatically controlled electric heaters. Storage space for the fuel oil used in the dryer burner is provided by another tank near the dryer.

Atomic Bombing Effects on Japanese Water Supply Systems

The United States Strategic Bombing Survey report on the effects of atomic bombing on the water supply facilities of Hiroshima and Nagasaki.

IN EVALUATING the effects of aerial bombing on the public water supply, data were obtained not only on the damages incurred or on the extent of interruptions in service, but also on the systems existing prior to the time of the first aerial bombardment. Sources of information were the prefectural and city health departments, waterworks officials, city engineers, and at Nagasaki, the Military Government officials.

The officials concerned with environmental sanitation were cooperative but were unable to supply detailed records concerning their activities. According to their statements all such records were destroyed in the bombing. The information obtained, while in round numbers in many cases, appeared to be reasonably correct and sufficient for the purpose of the Survey. In general, the officials appeared to be still in a state of confusion and this was admitted by some of them. Lack of records, loss of equipment, and shortage of manpower together with the apparent lack of aggressive leadership may have been responsible in part for this confusion. It should also be considered that many of these officials had lost their homes and were still concerned with matters pertaining to their own and their families' existence.

The Public Water Supply of Hiroshima

The public water supply is obtained from wells sunk in the bed of the Ota Gawa, about 1½ miles north of the city. The water is filtered through uncovered slow sand filters and under normal conditions the water would be chlorinated before delivery to the distribution systems. The capacity of the plant was given as 26 million gallons per day, with an average daily consumption of 17.8 million gallons, or 45 to 50 gallons per capita. The distribtuion system covered the greater part of the city and prior to the bombing supplied 90 percent of the population (estimated at 400,000).

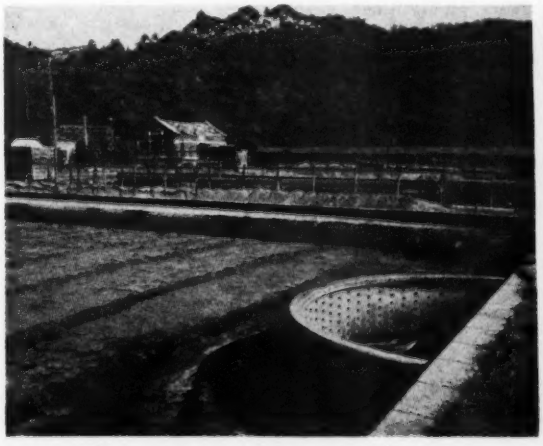
The treatment plant had been operated under laboratory control prior to the bombing, but no records were available at the plant laboratory. All records forwarded to the city office and laboratory were destroyed in the bombing. The shortage of chlorine following the outbreak of war caused a break down in chlorination of the water and practically no chlorination was practiced for some time prior to the bombing. From such evidence as was available the raw water from the river wells was free of turbidity, low in organic matter, total solids, hardness, and bacteria. It did not always meet the standards set for finished water, which is 50 bacterial colonies per milliliter, as determined by total count on nutrient agar incubated at 37° C. for 24 hours, and no coliform organisms in one milliliter, as determined by colonies on Endo medium incubated at 37° C. for 24 hours.

No information was available on the bacterial content of the water as delivered to the system during the periods just prior to and since the bombing. During these periods, however, even in the absence of chlorination it is believed that the water as delivered to the system was and is still of safe quality.

No alternate plans were made for supplying drinking water in the city in case of bombing, reliance being placed upon the numerous wells existing throughout the city.

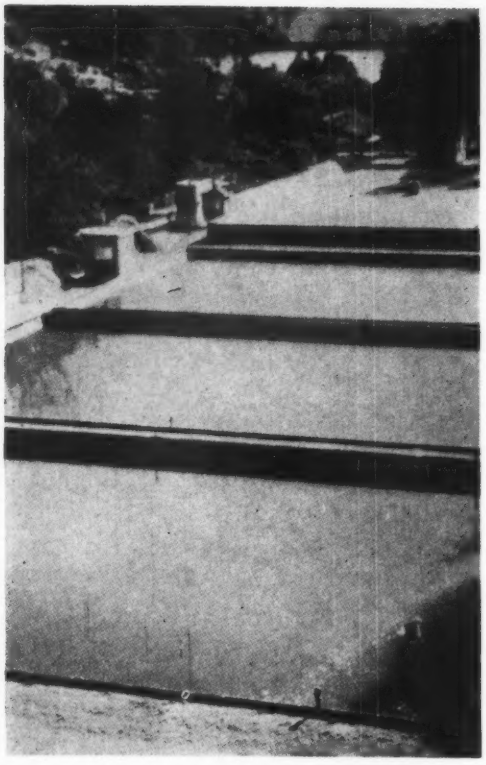
Damage to the Water System

Damage to the water system due to the bombing was primarily in the distribution system. Damage to the pumping and treatment plants was not sufficient



Slow sand filter unwatered and in process of being cleaned.

Flush-type fire hydrant in street supplies water for domestic use. Note low pressure and opportunity for back syphonage.



Sand filter beds and covered storage reservoir. Hongochi-high water plant, Nagasaki.

to interfere greatly with their operations. Considerable damage occurred in the plant laboratory and much of the equipment was made unserviceable. Damage to the distribution system in the city was mainly to the building and house service connections, the only major break in the large mains occurring at a river bridge crossing.

The service pipes to practically all destroyed buildings were broken or leaking, following the explosion. It was estimated that there were approximately 70,000 of these. Nothing had been done up to the date of the survey. to shut off these broken services and prevent the excessive loss of water.

At the time of the survey the treatment plant was operating normally, but no laboratory work had been carried on since the bombing, although the damage to the laboratory was not such as to warrant more than a few days break in carrying on essential examinations.

The whole plant was untidy, perhaps due in part to the difficulty of obtaining labor and necessary materials. The amount of water being delivered to the city was approximately 15 million gallons per day, the major part of which was being wasted through broken service pipes. The water pressure in the city had dropped to about 15 pounds per square inch and little or no water was reaching the undamaged sections of the city. It was stated that the booster station supplying the higher sections of the city was put out of service by the typhoon and was inoperative at the time of the survey.

In general, therefore, the water supply as delivered from the treatment plant was probably safe but was not available to a considerable part of the existing populated sections. The low pressure and the large number of leaky services made backflow possible.

Private Water Supplies

At Hiroshima, as in all the coastal cities, shallow wells of both the dug and driven type abound. No estimate could be obtained as to the number of wells, but it was stated that wells were accessible to 85% of the population. Based on the number of wells reported in other cities, there probably are at least 15,000 in Hiroshima. These wells varied in depth from 20 to 40 feet, depending upon the topography. The larger buildings, hospitals, and factories generaly had drilled wells to supplement the city supply; these were 300 feet or more in depth.

It was stated that the water from these shallow wells was not used to any extent for drinking in the delta area of the city but was used for all purposes in the outskirts and in the higher sections. In general, the shallow wells were fairly well protected from surface pollution and the pumps used were of the force-pump type. It is questionable if these shallow wells were safe for drinking purposes, however. No information was available as to the water quality.

In the bombed area all shallow wells were put out of service due to the debris and to the heat damage to pumps. These wells therefore ceased to be any health menace following the bombing.

The Public Water Supply of Nagasaki

The public water supply of Nagasaki consisted of 4 impounding reservoirs located on the southern, eastern, and northern outskirts of the city. Water from these reservoirs, known as Kogakura, Hongochi-high, Hongochi-low and Nisiyama-high, was treated by slow sand filtration and post chlorination in 4 independent plants having a combined capacity of 10,230,000 gallons per day. Flow was by gravity into the distribution system from storage reservoirs at the plants. These reservoirs had served the city for 56 years, beginning in 1889, and the supply had been adequate except during periods of severe drought such as occurred in 1939-40.

In August, 1940, construction was begun on a fifth reservoir and plant, known as the Urakami supply. Treatment was to consist of coagulation, rapid sand filtration, and post chlorination. Because of the shortage of labor and materials, however, only two of the six filters were equipped. These were housed in a temporary wooden building. Thus the available supply was increased to 13.3 million gallons per day, which on the basis of 220,000 persons served, was equivalent to 60 gallons per capita per day. The total consumption at that time was approximately 10,000,000 gallons per capita per day, a quantity considerably smaller than experienced in United States cities of comparable size. However, the Japanese system of plumbing is such that very little water is required for flushing purposes. Furthermore, there were an estimated 10,000 private wells scattered throughout the city which were available to some 50,000 persons as sources of water, particularly for laundry and cleaning purposes.

Explosion of the atomic bomb on 9 August 1945 caused the collapse of the temporary building housing the two filters, damage to the equipment, and destruction of the power lines necessary for operation of the pump for lifting the water from the clear well to distribution system. But since the other reservoirs and plants were not damaged by this blast and since the population of the city was materially reduced at the time, a shutdown of this plant did not result in a water shortage.

In regard to quality of water, little data could be

obtained from records of past analyses since the laboratory building and equipment, including most of the records, were destroyed by fire following the raids. Information obtained from the water department indicated the raw water impounded in the reservoirs to be relatively free from pollution. The filters were operated at rates considered within the ranges of good practice for water of this character and all water was purported to be chlorinated at an average rate of 0.5 parts per million before storage.

Records of analyses conducted during the year 1945 were destroyed. Hence no information was available on the quality of water during and after the bombing attacks. However, there is no reason to believe that the quality was impaired since none of the reservoirs or filtration plants was seriously affected by aerial bombing of the city.

Effect on Quality of Water

Indirectly, the air attacks did have an effect on the quality of water in all cities depending upon chemicals for coagulation or disinfection. The supply of liquid chlorine to Nagasaki was seriously depleted during the war and was eliminated entirely some time prior to the first raid on the city. Whether this was due to destruction of chlorine manufacturing plants or disruption of transportation facilities is not definitely known. Nevertheless, the chief of the city water works reported that the use of liquid chlorine had to be discontinued and that chlorinated lime solution was used as a substitute. This was verified by a visit to one of the slow sand filter plants (Hongochi-High) where the liquid chlorine feed equipment appeared to be deteriorated from lack of use and where chlorinated lime solution was being used. This was some time after occupation by United States troops, and it is questionable whether chlorine was applied continuously during the war, particularly after the air attacks.

It was stated that the raw water from the reservoirs was usually low in bacteria, including the coliform group. Judging from the nature and development of the watersheds supplying the reservoirs, there is little reason to doubt this statement. Although the watersheds are inhabited to some extent, there are no sewers carrying fecal material in the area and, although human feces was extensively used for fertilizing the farm land on the area, the proportion of farm land to uncultivated land is quite low and the cultivated land is laid out in such a manner that there is little run-off of fecal-bearing water into the reservoirs. Hence, it is doubtful whether the quality of water was seriously impaired even though chlorination was discontinued entirely, particularly in the case of those supplies treated by slow sand filtration.

Other Damage to the Water System

In addition to the damages already mentioned, the Japanese officials reported a total of 17 breaks in the main feeder pipes of the distribution system, numerous breaks in the smaller laterals, and approximately 5,000 breaks in house service lines. High-explosive bombs dropped prior to 9 August were responsible for 16 breaks in pipes of the distribution system and 12 additional breaks occurred as a result of the 9 August atomic bomb, all of the latter being within 850 yards of ground zero. Most of these breaks were in the nature of fractures to the cast-iron pipe where it had been laid on filled ground, due to the impact of the explosion being transmitted in the form of earth pressure. In some places, however, pipe joints were loosened by the impact and the lines leaked. The damages to house service lines were in the nature of breaks caused by fire and destruction of the buildings. These breaks resulted in a tremendous loss of water and a disabling reduction in pressure until the line could be shut off or the break repaired. Water officials attempted to provide water to the stricken area before repairing the breaks but the pressure was too low and the effort was given up as hopeless. It was estimated that damage to the mains was repaired within 2 weeks after the raid and that most of the breaks in house services were repaired within a month. However, many house lines were observed to be leaking at the time of this survey and it is believed that many more breaks were buried in the debris. The estimate of 10,000,000 gallons per day water consumption at the time would tend to verify the belief that much leakage was occurring. No attempt was made to disinfect the repaired sections of pipe nor were samples collected to determine whether the water was bacterially satisfactory before placing the line in service.

Health Hazards

Insofar as health hazards are concerned it is believed that the water supply was not seriously affected as a result of bomb damage. Loss of the Urakami supply would have been a serious factor had not the industrial activities and population been reduced at the same time. However, since these decreases did occur the remaining four supplies provided sufficient water for sanitation purposes and since these supplies were not damaged, the water was of no worse quality than that before the air raids took place.

The lack of chlorine for disinfection was somewhat of a factor in that good practice would dictate an increase in dosage during and following an air raid to provide an additional factor of safety in protecting the water in the distribution pipes against contamination resulting from backflow of polluted water. Where breaks in the distribution system occurred there was a definite opportunity for polluted water to be drawn into the system because of the drop in pressure. But if such pollution did occur, it apparently had no disastrous results as no major epidemic of water-borne disease that could be traced to the water supply was evident.

Private Water Supplies

In the event that the main supply was destroyed, city officials planned to use the 10,000 private wells scattered throughout the city as a source of drinking water. These dug wells were approximately 3 feet in diameter and 10 to 30 feet deep. Some were provided with hand pumps, others with ropes and buckets. No particular attempt was made to protect the wells against contamination. About 50 percent had wooden covers but for the most part these were not tight fitting. Samples of water from these wells collected during a survey by city officials and students of the local medical college in October 1944 indicated 80 percent to be polluted. At that time the various owners were notified of the conditions and warned to boil the water before using. Had it been necessary to use these wells as an emergency source of drinking water, city officials intended to treat them with chlorinated lime before allowing distribution to the people.

[Editor's note: Among the officers engaged in this survey were Ralph Tarbett of the Public Health Service and Paul Houser of the Sanitary Corps.]

Individual Sewage Disposal—Small Septic Tanks for the Housing Program

Recommendations of the Joint Committee on Rural Sanitation, including the Dep't. of Agriculture, Conference of State Sanitary Engineers, National Housing Agency, Federal Security Agency, Dep't. of Interior and Tennessee Valley Authority.

IN CONNECTION with the Veterans Housing Program, minimum requirements for individual sewage disposal systems for homes beyond sewer lines have been prepared by a committee representing the above governmental departments. These have been published as reprint 2461 of the U. S. Public Health Service, revised 1947. The Public Health Service is now engaged on a program of research on this subject, but the results of these investigations will not be available for some time to come. For the present, therefore, the regulations which are summarized herein will apply to Veterans Housing.

Grease Interceptors. — These are not considered necessary for individual homes, though some states require them. They are considered necessary for establishments with large kitchens. When used, grease interceptors should be accessible and for a single-family dwelling should have a capacity of about 30 gals. Fig. 1 shows two types that are approved.

Building Sewer. — This should be of durable pipe, as vitrified clay, cast iron or concrete; bituminous joints are preferred for other than cast iron, with which lead or similar joints should be used. Where a septic tank is within 25 ft. of the building, cast iron pipe is preferred. Essential features of the building sewer are: (1) Minimum size 6″ if of vitrified clay or concrete; 4″ if of cast iron; (2) minimum grade 1% or 1 ft. in 100, but twice as much is preferable; (3) grade for 10 ft. immediately preceding the tank should not exceed 2%; (4) cast iron pipe with good joints should be used when the line is within 50 ft. of a well or suction line, 10 ft. from any drinking water line under pressure and 5 ft. from basement foundations or when laid beneath driveways with less than 3 ft. cover. Cleanouts should be placed at changes in line of 45° or more and in grade of 22½° or more; 90° bends should be avoided. All joints should be watertight and protected from damage by roots.

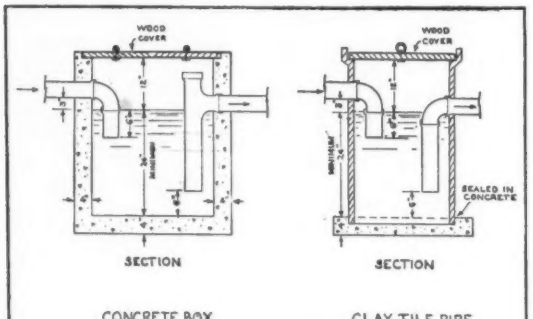


FIG. 1-GREASE INTERCEPTORS

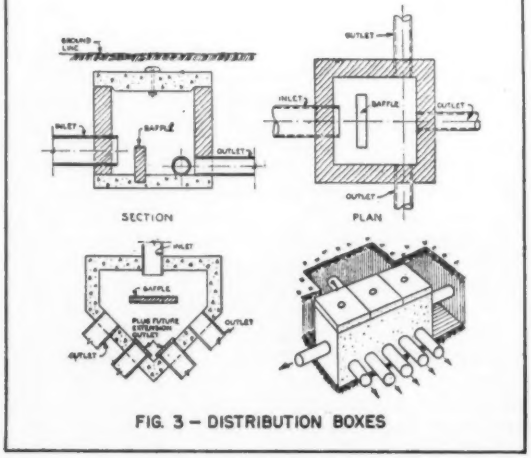


FIG. 3 – DISTRIBUTION BOXES

Septic Tanks and Dosing Chambers

The Septic Tank—The septic tank should be located where surface drainage is away from all sources of water supply; elevation should be such as to give proper grade for the sewer from the house. Low, swampy areas should be avoided. (Also stay away from rocky areas—Ed.) Properly made tanks need not be any specific distance from the house; location should be chosen to make an ample area available for the disposal field. Excessive cover is unnecessary—12 to 18″ is sufficient, except in very cold areas. Minimum capacity of the septic tank should be 500 gallons, and more for houses having more than two bedrooms. Design should be based on the average daily flow of sewage, a retention period of 24 hours, and adequate sludge storage. Allow 50 gals per person daily for dwellings, 25 for camps and 17 for day schools, with a minimum of 500 gals. Where domestic garbage grinders are to be used, increase tank capacity 50%.

There is little need for multiple chambers. The inlet compartment should have a capacity not less than two-thirds the total. Inlet baffles should extend 12″ and outlet baffles 15″ to 18″ below the liquid level, and both 6″ above. The inlet invert should be 3″ above the outlet invert. The tank cover should be designed for a dead load of at least 150 pounds per sq. ft. Where covers are not removable, a manhole (or two of them) should be provided. Prefabricated tanks of the proper design and capacity are acceptable; metal tanks should be at least 12-gauge and should be treated or coated to prevent corrosion.

Dosing Chamber.—Dosing chambers with automatic siphons are not recommended with septic tanks for individual dwellings, primarily because of the cost; for installations to handle 1000 gals. per day or more, they are desirable, especially when a variety of sand filter is used for final treatment. The liquid capacity of the dosing chamber should be 50% to 75%

FIG. 4 – SUBSURFACE DISPOSAL FIELDS

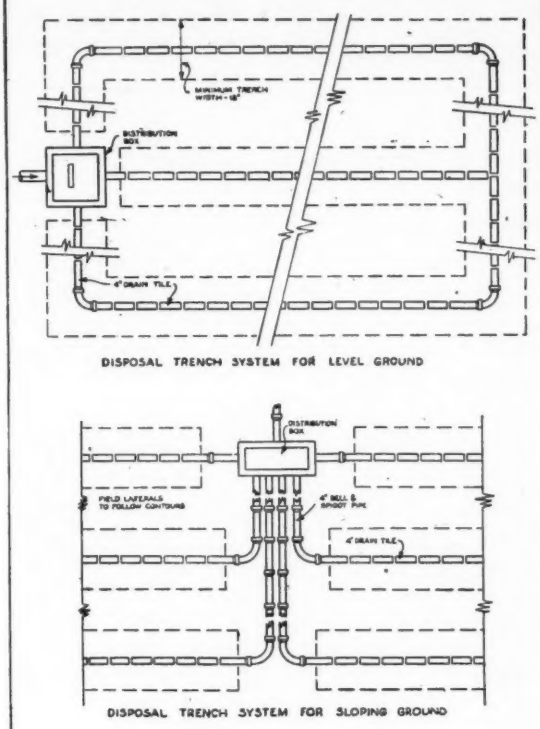
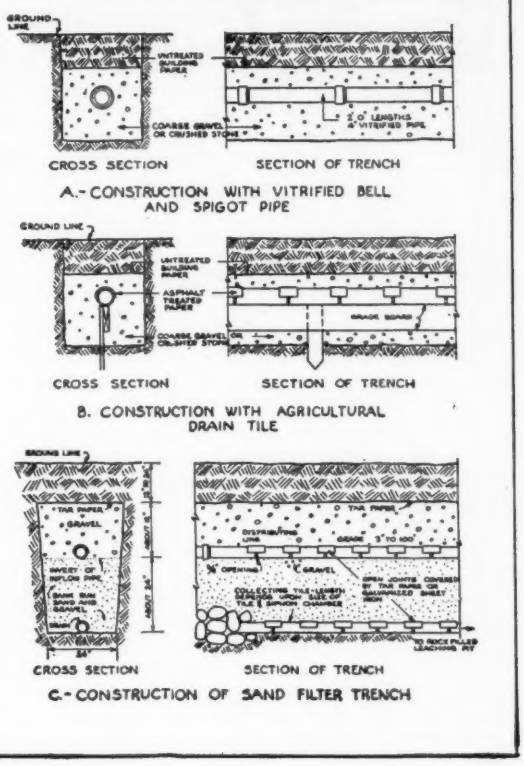

DISTRIBUTION BOX
4" DRAIN TILE
DISPOSAL TRENCH SYSTEM FOR LEVEL GROUND
DISTRIBUTION BOX
FIELD LATERALS TO FOLLOW CONTOURS
4" BELL & SPIGOT PIPE
4" DRAIN TILE
DISPOSAL TRENCH SYSTEM FOR SLOPING GROUND

FIG. 5 – SUBSURFACE DISPOSAL TRENCHES AND SAND FILTER TRENCH



of the capacity of the field disposal lines, and discharges should occur at 2 to 3-hour intervals, or less frequently. Rain water and surface or foundation drainage should not enter the tank.

Distribution Box.—A distribution box should be located at the upper end of the disposal field in order to feed the flow equally into all lines. Details of approved boxes are shown herewith, Fig. 3. Diversion boards should not be installed in systems serving individual homes. but are desirable for installations with large flows.

Subsurface Disposal Design

Subsurface Disposal.—Disposal fields should be at least 100 ft. from any water supply well (50 ft. from a drilled well with a casing 50 ft. or more deep); 25 ft. from a stream and 10 ft. from dwellings or property lines. Permeability of the soil as indicated by percolation tests (see below), should form the basis for design. For dwellings, flow should be assumed at 100 gals. per bedroom per day; for buildings used only in the daytime, flow will be 30 to 60 gals. per person per day.

Vitrified bell and spigot pipe, extra strength drain tile or even agricultural drain tile may be used; lengths should not exceed 24-in.; joints should be spaced one-fourth to one-half in.; the upper part of the joint should be protected with asphalt treated paper. Tile without bells should be laid on a grade board. Trenches should be not less than 18 ins. wide, and may be somewhat more. Filter material should be not less than 6 ins. deep below the bottom of the tile, and should provide a cover of at least 2 ins. over the tile. Gravel, crushed stone, slag or other durable coarse porous material may be used. The porous material should be covered with straw or building paper before backfilling. Surface water should be diverted from the trenches.

The lines of tile should not be less than 6 ft. apart, and may be more. Grade should be between 2 and 4 ins. per 100 ft. and should not exceed 6 ins. under any condition. Cover should be such that tile lines will not be covered more than 18 ins., if possible; when cover of more than 30 ins. is necessary due to topography, other designs should be considered. In very cold areas, the tile may be placed under 3 ft. of cover and the trenches, using coarse porous filling, extended below frost. Maximum length of individual lines should not exceed 100 ft., and at least two lines of tile should be provided. Where two levels of disposal field are necessary because of considerable slope, drop connections should be used, but the bottoms of the trenches should not be connected.

Making the Percolation Test.—In making the percolation test, care must be taken to obtain accurate results. Excavate a hole 1 ft. square and to the depth of the proposed disposal lines, generally 24 to 30 ins. Fill with water to a depth of 6 ins. or more; after the water has seeped out, again fill the hole to a depth of 6 ins. and note carefully the time for the water to seep away completely. Divide this time by the depth of water (usually 6 ins.) From the time required for the water to drop 1 inch, turn to Fig. 2, and determine the effective absorption area required; however, a minimum of 150 sq. ft. should be provided for each individual dwelling unit. Absorption area is based on the area of the bottom of the disposal trenches. If these are 18 ins. wide, the absorption area will be 1.5 sq. ft. per ft. of trench, and for 150 sq. ft., a total of 100 ft. of disposal area, composed of two lines each 50 ft. long will be required. Layouts are shown in Fig. 4.

Sand Filter Trenches.—In tight soils, subsurface

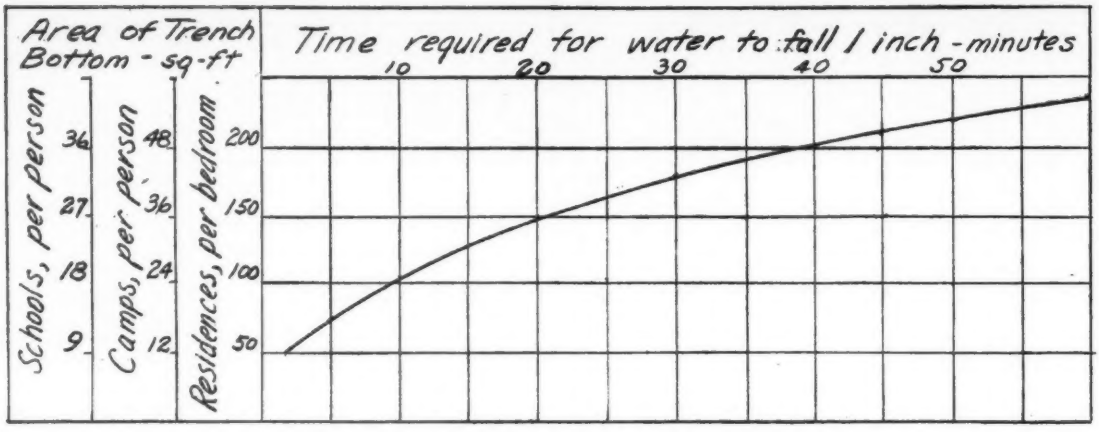


Fig. 2. How to determine field requirements from percolation tests.

disposal is difficult or impossible. Sand filter trenches may be used. An approved type of construction is shown in Fig 5c. The effluent from the lower line of pipe may be discharged into a seepage pit; or, with the approval of the State Department of Health, it may possibly be discharged into an open ditch or water course.

Seepage Pits.—General location should be the same as for disposal lines, and the distance between pits should be at least three times the diameter of the larger. Excavations should not extend into the ground water table, and pits should not be used where underground waters may be contaminated. In general, pits should be used supplementally to subsurface disposal fields. A diameter of at least 3 ft. is desirable, with depth at least 6 ft. into porous soil. An open joint lining, backed up with 3 ins. of gravel to the elevation of the inlet; and a manhole-type top are desirable. Coarse gravel should be placed to a depth of at least 1 ft. before the lining is installed. When close to trees, the lining may be omitted and the entire pit filled with loose, coarse stone. Capacity should be at least equal to that of the septic tank, and in impervious soils twice as great. Based on the gross diameter (outside of the gravel backing), the following effective absorption areas should be provided per bedroom for dwellings: In coarse sand or gravel, 20 sq. ft.; in fine sand, 30; in sandy loam or clay, 50; in clay with considerable sand or gravel, 80; and in clay with little sand or gravel, 160. For camps, an area should be provided per person one-fourth of the above; and for schools, one-sixth of the above. Area includes the bottom and the sides to the elevation of the inlet.

Cesspools.—A cesspool is not recommended as a substitute for a septic tank as the raw sewage quickly clogs the soil. Also, cesspools are considered a definite health hazard, and should be used only subject to State Board of Health approval. Abandoned wells, drillholes or abandoned mines should not be used either as cesspools or as seepage pits.

Sewer Charges Average One-Fourth of Water Bill in Texas Cities

A total of 258 cities in Texas make a charge for sewerage service, according to a survey conducted by the League of Texas Municipalities. Of these cities 96 have populations below 2,500, 122 from 2,500 to 10,000, 30 from 10,000 to 25,000, and 10 above 25,000. The survey showed that sewerage rates based on water consumption are employed by most cities above 25,000, while the smaller cities prefer a flat rate or a charge based on the number of plumbing fixtures or the type of property. The average monthly bill for 24 cities under 2,500 in 1945 was 74 cents and for 10 cities between 5,000 and 10,000 the average bill was 60 cents. It was found that where uniform or flat rates are used no attempt is made to base the amount of the charge on the extent of use; where any distinction is made the city usually has one rate for residential customers and another for business places. —*Public Management.*

Laboratory Develops Marginal Soil Stabilizer

The 1946 report on the activities of the New Mexico Highway Department Testing Laboratory located at the University of New Mexico in Albuquerque, indicates that the outstanding achievement of the 1946 season was the development of a method for making usable vast quantities of marginal stabilizing material. By marginal is meant deposits of caliche, sandy gravel, and gravel which contain too much clay to meet highway specifications and are therefore unfit for use without addition of sand. In many sections of the State sand is not available.

To meet this contingency the laboratory began experiments to determine if these marginal materials could be improved by incorporating with them small amounts of cement. The object was not a soil-cement, as this term is generally understood, which would involve percentages of cement ranging from 6 to 12 percent, but only enough cement to counteract the clay.

Two Federal Aid projects had developed very bad surface failures which were directly traceable to failure of the underlying base course, a crushed caliche. The caliche was a marginal type, carrying enough clay to render it plastic in the presence of excess moisture.

Samples were taken at close intervals over the two projects and brought to the laboratory for analysis. Preliminary tests indicated that the addition of 2 percent by dry weight of cement would counteract the effect of the clay. Samples were made up in this proportion and placed under water. At the end of two years the samples were still firm, volume change was negligible, and absorption well below allowable limits.—*Highway Research Abstracts.*

Grass Sowing Under Film of Bitumen Emulsion

By H. W. JARVIS, A.M.I.C.E.
Divisional Surveyor, Middlesex County Council

IN September, 1943, 13 Airfield Construction Group, R.E., of which the writer was a member, were instructed to carry out grass sowing on a portion of an advanced landing ground at Headcorn, Kent. The method used was to incorporate a proprietary brand of peat in the soil, sow grass seed in the normal way, cover with ⅛ in. sand, spray with a proprietary brand of non-toxic bitumen emulsion, cover with another ⅛ sand, and roll with a heavy hand-roller.

A series of similar experiments is described in a pamphlet, "A Study of the Growth of Grass Seed in Surface Stabilised Soil," by Martin A. F. Sutton, F.L.S., T. F. N. Alexander and F. C. West, B.Sc.

Owing to the remarkable results obtained at Headcorn, it was felt that further investigation was justified. The stimulus to the rapid germination of the grass seed, under practically any weather condition, seemed to be due to the film of bituminous emulsion rather than to the incorporation of peat. Accordingly, a series of experiments was carried out on the sites of air-raid shelters which had been demolished and grass verges in South-West Middlesex. The following is a brief description of the experiments carried out, materials used, and the results observed during the past growing season.

Preparation of the Site

In almost every case soil had to be brought to the site before sowing could be carried out, and this was top spit from the site of an extension to a gravel pit near the river Thames. This new soil had to be well consolidated and levelled with repeated rolling and raking during dry weather. As the part of Middlesex in which this work took place has a gravel subsoil, no extra drainage was needed, but it is vitally important to provide adequate drainage on heavy or clay soils.

When the plot had been made as firm and level as possible, the surface was very lightly raked over to obtain about ½ in. of fine tilth, into which the grass seed was raked before the first layer of sand was applied.

As bitumen emulsions normally used for surface dressing carriageways are non-toxic, the emulsion used for spraying on the soil was taken at random from consignments delivered for other purposes, and in no case was any adverse result shown. Emulsion from six different manufacturers was used. The best grade seemed to be that containing 55 per cent bitumen sprayed at the rate of 6 to 7 sq. yds. to the gallon, using a normal cold emulsion sprayer.

This bituminous film on the soil has a twofold effect: First, it conserves any heat that may be present at the time of sowing, and secondly, by suction, it draws up the moisture to the surface from a considerable depth, thus providing warmth and moisture, the two essential agents for speedy germination and subsequent growth.

It was observed that where the film of bitumen was sprayed thicker than that described above, the grass shoots took a much longer time to break through the surface, and it appeared that most of the finer grasses in the mixture were—if they germinated at all—unable to get through this heavy cover. The result was a sparse growth of coarse grass which soon became sickly in appearance, and which no amount of after treatment could turn into a good greensward.

It is advisable to use clean, sharp sand both above and below the film of emulsion, as the sand below the emulsion splits up the tufts of new grass into separate shoots, making a more even sward. The sand above the emulsion amalgamates with the film and makes this crack up more easily under the pressure of the growing grass.

Experiments showed that the minimum quantity of seed to obtain an even sward that can be thrown open to the general public immediately after its first cut was 2 oz. per sq. yd.

One remarkable result in this form of sowing is the complete freedom from annual weeds. Air-borne seeds are unable to germinate, as their roots are unable to pierce the film of bitumen emulsion, while, for some reason at present unknown, the seeds of weeds present in the soil do not germinate, while the grass seeds germinate at a very rapid rate. From April until early October, the grass shoots never failed to appear in eight days or less.

The process as outlined above gives young grass of a brilliant green color. As soon as the grass starts losing this brilliant color and turning brown or yellow, it is a sign that aeration of the soil is needed, and this is most conveniently carried out with a spiked roller.

From observation kept on the soil under the film of bitumen, it is obvious that the presence of this film on top of the soil sets up a strong capillary action—*e.g.*, two days after a sowing had been made in dry dusty soil a small portion of the film was lifted and the soil was found to be quite damp. Owing to the wet summer, extended observations on this particular aspect were not possible, but further observations will be carried out during the present year and a further report presented.

Advantages of the Method

If the continued growth of grass by this method can be established, it will be of great importance, as in other years spring sowings were almost a total loss through drought during May and June. Another noticeable point is that the grass is of a very tough and wiry texture, which makes it more difficult to cut, but, on the other hand, gives a hard-wearing quality which is of importance for public parks and roadside verges. One great advantage of this method of grass sowing is the prevention of mud, as mud is most cumulatively destructive to grass that is open to constant foot traffic in wet weather.—Republished from *The Surveyor*.

Road Debts Down in Michigan

According to a recent report of the Michigan Good Roads Federation, that state now has no road debt; and the county road debt is down to $5,500,000. Data on present street debt of cities are not now available, but it is believed that it is materially below the 1935 mark of $36,500,000.

Public Works Engineering Methods and Data

Virginia's First Three-Level Underpass-Overpass

Shown herewith is the artist's conception of a three-level highway interchange now under contract for construction in Norfolk county, Va., at the congested intersection of Routes 13 and 460. When completed, the interchange will eliminate a serious traffic bottleneck and will forge the final link in a four-lane bypass around Norfolk city. Artist's drawing by Francis Wiley Powell, of the Virginia State Highway Department, was made to scale from engineering blueprints. Route 13 (Norfolk bypass) crosses at top level, with Routes 460 and 166Y passing beneath the Norfolk and Western railroad tracks. A connecting road runs on the plane of the railroad track. The project should be completed by late next year. Contractors are E. W. Grannis Co. and Lewis and Bowman Co., of Fayetteville, N. C.

Cost Data on Maintenance of Turf Shoulders for Highways

In a report to the Highway Research Board by a special committee of which P. L. Blackwell was chairman, some data on cost of maintaining turf shoulders was given. E. L. Worthington of West Virginia made these comparisons: (a) Grass shoulders are cheapest to maintain; (b) Stabilized shoulders of selected material next cheapest; and (c) Earth shoulders are most expensive to maintain.

Maintenance engineers of Virginia have made a comparison between the cost of maintaining grass shoulders adjacent to narrow pavements and adjacent to wider pavements, each carrying a varying volume of traffic. It appears from this comparison that it is more expensive to maintain a grass shoulder along a 20-foot roadway than the same type shoulder along a 30-foot roadway, even though the latter carries considerably more traffic. In one district of the State it is shown that grass shoulders have been satisfactorily maintained where the volume of traffic on a two-lane road was under 1000 v.p.d., on a three-lane road from 1500 to 2000 v.p.d., and on a four-lane highway from 3000 to 4000 v.p.d.

Mississippi reports that the average maintenance cost of grass shoulders over several years was $55.70 per mile. These shoulders were not totally grass covered. Certain sections were partially stabilized or paved. One section, having three-fifths of the width grass covered and the remaining two-fifths treated with gravel, cost on the average of $11.50 per mile over a 5-year period.

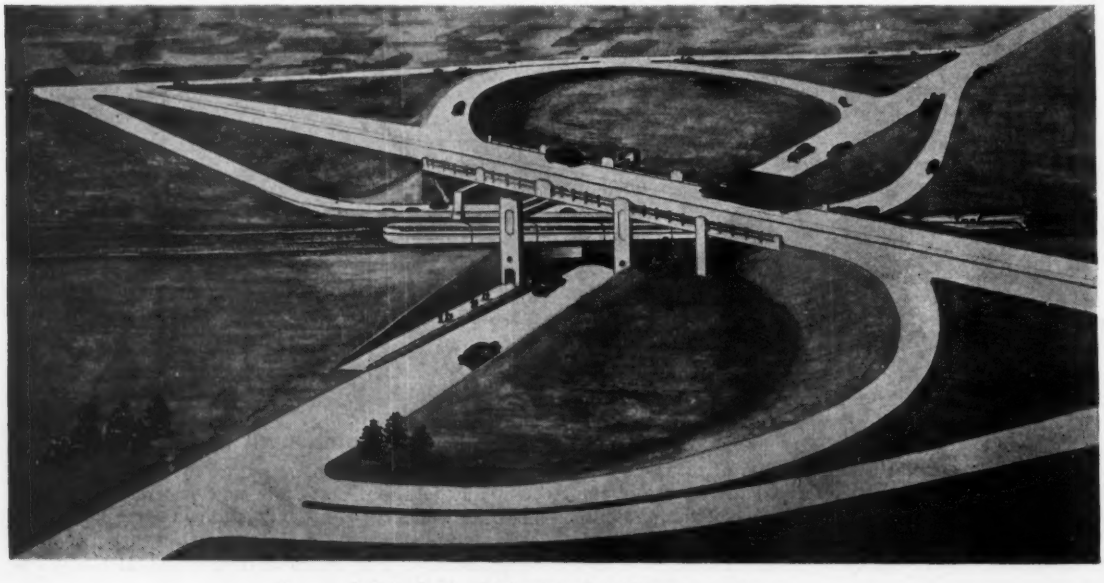
Indiana maintenance men contend that it is cheaper, where possible, to widen all surfaces of 16 feet, 18 or 20 feet to 22 feet, using grass shoulders adjacent to the wider surface than to maintain narrower surfaces with consequent expensive shoulder maintenance.

Minnesota reports little difference in the cost of sod or grass shoulder maintenance and the cost of maintaining gravel shoulders.

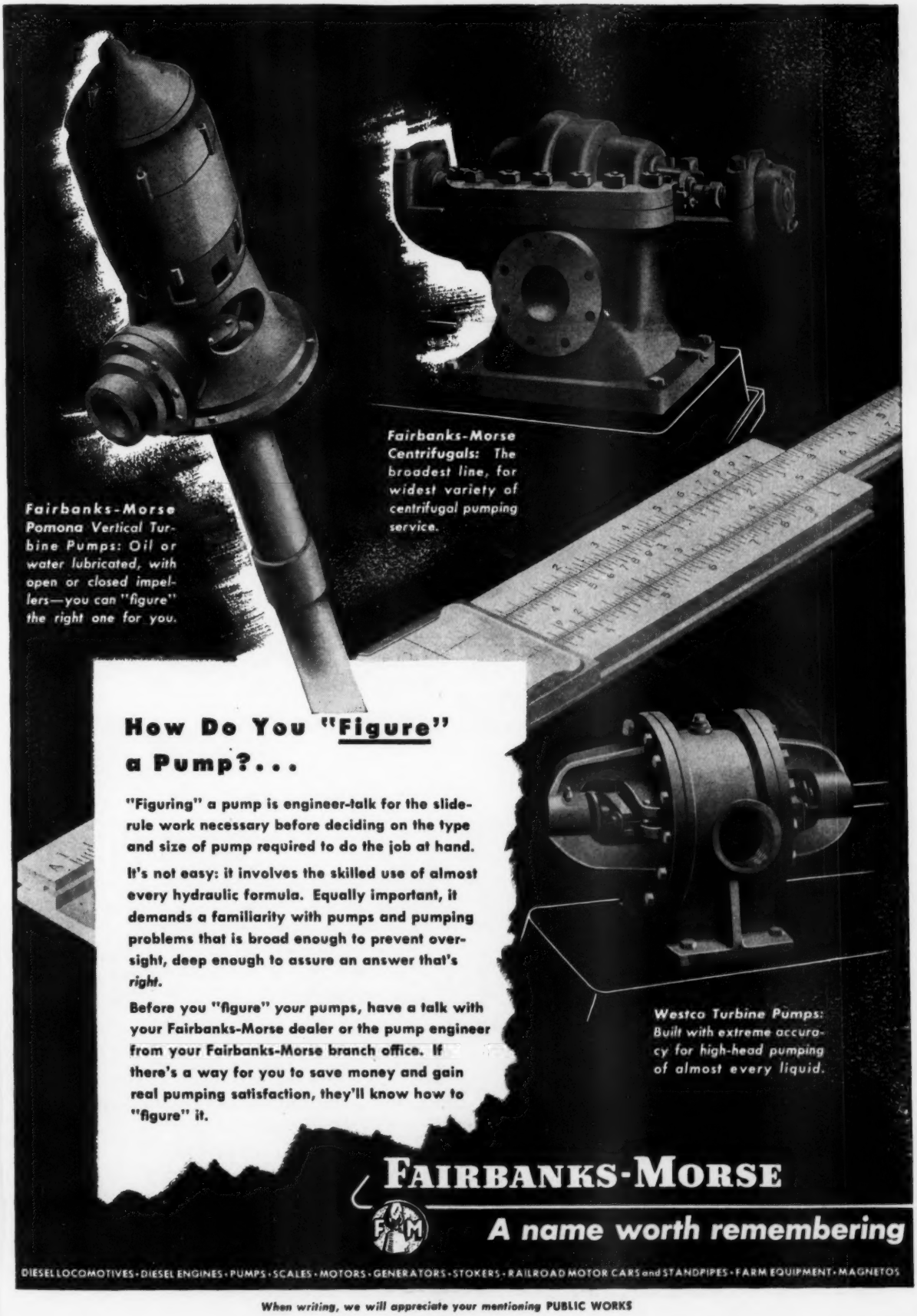
New Sewage Treatment Equipment Installed in Los Angeles

New sewage treatment equipment—the largest electrically controlled chlorination installation in the world—has been put into operation by the City of Los Angeles.

The Bureau of Sanitary Engineering of the State Department is cooperating with the City of Los Angeles in collecting and analyzing bacteriological samples from a network of stations along the beaches of Santa Monica Bay to test the efficiency of the new



Artist's sketch of Virginia's first 3-level underpass.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It's not easy: it involves the skilled use of almost every hydraulic formula. Equally important, it demands a familiarity with pumps and pumping problems that is broad enough to prevent oversight, deep enough to assure an answer that's *right*.

Before you "figure" *your* pumps, have a talk with your Fairbanks-Morse dealer or the pump engineer from your Fairbanks-Morse branch office. If there's a way for you to save money and gain real pumping satisfaction, they'll know how to "figure" it.

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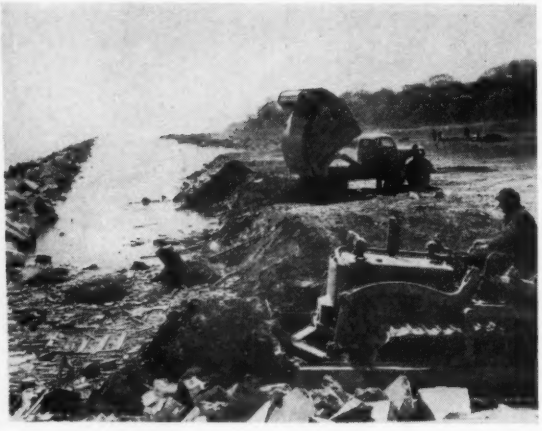

IHC tractor and Bucyrus-Erie bulldozer leveling Racine dump.

apparatus in preventing pollution of beaches and Bay waters. On the basis of these studies the department will consider possible modification of the state quarantine of more than 10 miles of beaches.

Tractor and Bulldozer Smooth Refuse Dump at Racine

Racine, Wisc., has three dumping areas along the lake front where 5000 yards of refuse is deposited every week. International TD-6 tractors are snown at work in both illustrations; and at the right is also shown a modern type of refuse collection unit used in Racine.

Sewage Disposal in Japan

The following data regarding sewage disposal practices and facilities in Japan appeared in the *Eighth* Army Octagram, and was forwarded to us by Lt. Col. Jack J. Hinman, Jr., of the Eighth Army Engineers:

Prior to the war Japan used chemical fertilizers. The ever present honey carts played the streets then as they do today but in a different function. They were then an important part of the country's sewage disposal system—carting waste from homes to barges for disposal at sea.

Today with chemicals at a premium the use of night soil has become an absolute necessity for farm lands.

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CAST IRON PIPE is rust-resisting. No other pipe lasts so long and cost so little per year.

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This oversize THREADED joint . . . with hex grips that hold the wrench firmly . . . makes it easy for even unskilled men to lay.

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Incoming Allied personnel are amazed and amused at the antiquated system of "honey carts"; yet these play an important part in the present economic system, as saviors in revitalizing the worn-out paddy fields and truck lands that produce the nation's main source of food.

The "honey carts" and the "bucketeers" function in an organized system known as the Hygienic Guild. Approximately 90,000 of Yokohama's 140,000 homes are served directly by the farmers in the neighborhood or use "honey" on their own garden plots. The remaining 50,000 homes are served by the Yokohama City Hygienic Section which is organized as follows:

The city is divided into 60 districts, each of which is served by a contractor belonging to the Hygienic Guild. These contractors employ 240 carts which haul from the individual homes to 40 collecting points and 11 barge sites within the city. The "honey bucketeer" earns 2,000 yen a month and fills 60 to 80 thirty-six liter buckets per day. The charge to the home owner is two yen, fifty sen per bucket.

At the barge sites, sludge, which is extracted principally from septic tanks and is rather low in fertilizer value, is separated and dumped into the sea. The remainder is sold and shipped by barge to neighboring prefectures.

From the 40 collecting points, the contractors operate a fleet of 23 trucks which haul night soil to 400 distributing points in the country. Here it is sold to farmer associations at one yen per bucket. Cost of hauling from Yokohama to the outlying areas averages two yen per bucket and this is subsidized by Yokohama City.

A distributing point consists of two large concrete tanks each separated into ten 720 liter (one truck load), compartments. Sludge is aged in the compartments until it reaches the exact stage for use as fertilizer. This is approximately two months in the winter and two or three weeks in the summer.

The city officials, being dissatisfied with disposal by dumping at sea, and looking forward to the time when chemical fertilizers are again available, have plans for a sewage disposal plant in Yokohama. A sanitary sewer system has also been proposed, but the amount of critical materials required and the tremendous initial cost of such a project will prevent its installation for a long time.

Snow Removal Equipment Needed for an Airport

The following snow removal equipment is needed in order to maintain safe operation on a major airport, Class IV or V, when snowfall averaged 70 inches per year, according to Neil Brackstone, airport manager, Department of Aeronautics, Lansing, Mich., in a discussion at the ARBA meeting:

Two one-way plows mounted on two 2½-ton all wheel-drive trucks equipped with dump bodies and underbody blades; one one-way plow with side wing mounted on 5-7-ton all wheel-drive truck equipped with dump body; one medium and one large rotary snow thrower, the medium mounted on 2-3-ton all wheel-drive truck and the larger on a 5-7-ton all wheel-drive truck; one of the rotarys should be equipped with loading device; one crawler-type tractor and one carry-all of 20-yard capacity; one trailer mounted sand spreader with sufficient cast to spread abrasives thirty to fifty feet. It would be advisable to buy materials to construct equipment to heat properly abrasive materials.

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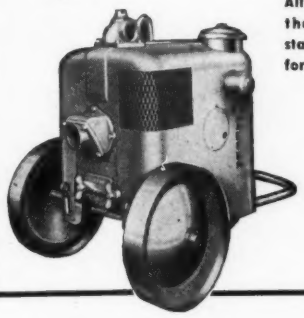

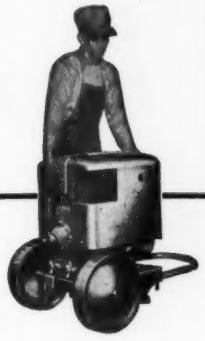

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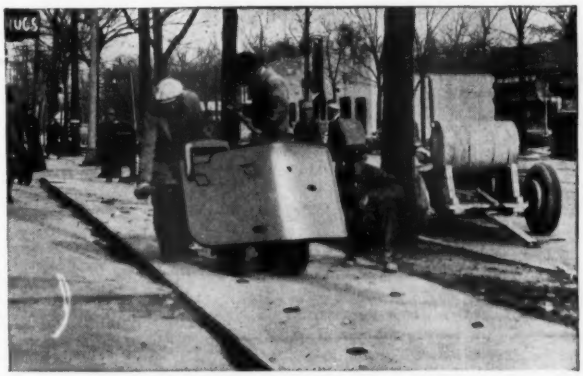

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MUD-JACK METHOD

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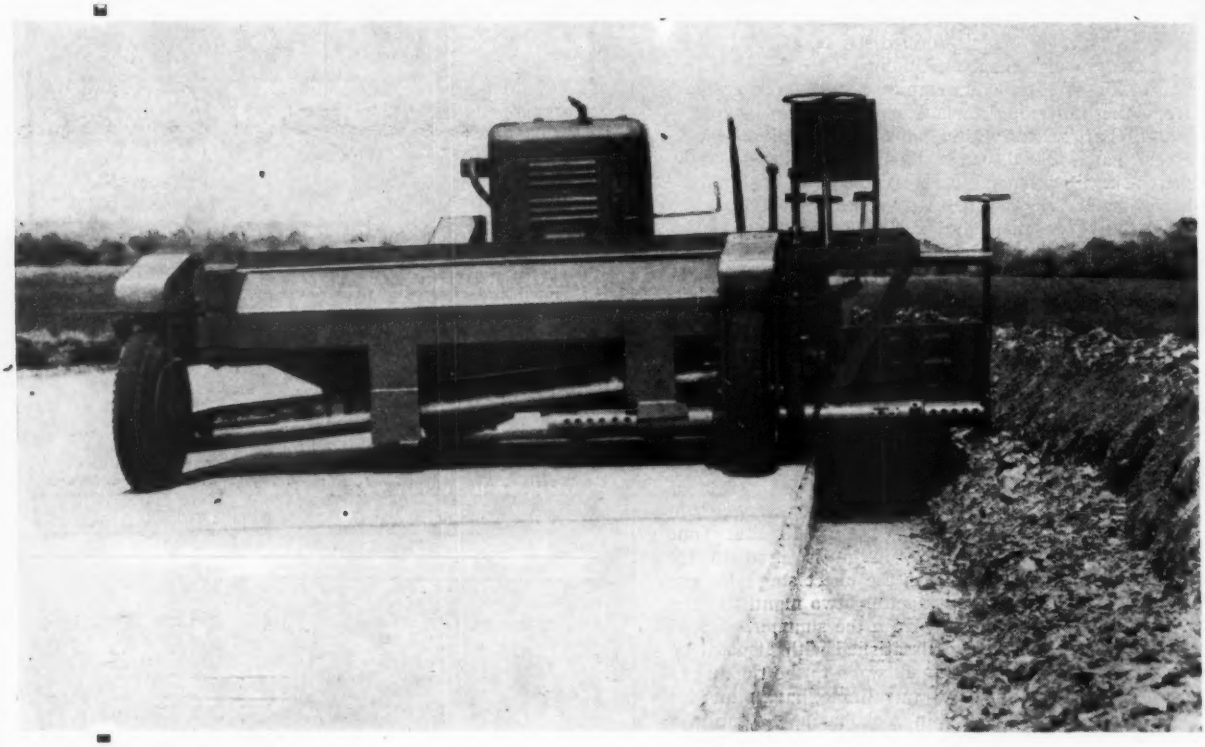
ROAD WIDENING
is Easy, Fast and Economical with an APSCO WIDENER



This APSCO Model 80 (front view) averages 5 tons per minute delivered and laid in the trench.

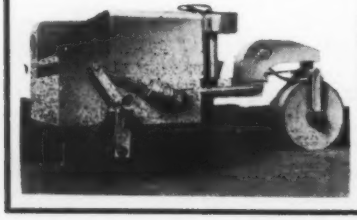
ECONOMICAL—This widener is ideal for road contractors and highway departments who have roads to widen or shoulders to build. In most cases forms are not required, effecting a considerable saving.

EASY—Two man crew operates it. Driver sits directly over the work—full view ahead and behind. All controls within easy reach, including independently connected brakes to driving wheels. Dump truck backs up to hopper, is pushed along as widener travels forward.

FAST—The general design and specifications, resulting from careful study of widening problems, together with broad experience, combine to produce an efficient, speedy machine which will soon pay for itself in time and money saved.

FLEXIBLE—Standard unit spreads 2' to 4' strip of sand, gravel, dirt, stone (not bituminous mix—altho Model 60 readily handles bituminous mix also) to any depth. Handles 6" or even larger material.

The APSCO *Trench Roller* is an ideal companion piece for the WIDENER. The pneumatic tired leveling wheel is a real feature of this machine. Write for details



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Why Standby Chlorinators Are Necessary

The seriousness of chlorinator failures is indicated by experience last year in New York State. Emergency chlorinators maintained by the State Health Department had to be installed to treat water supplies in eighteen communities where the regular equipment needed major repair. These chlorinators were in use a total of 925 days or an average of 51 days for each installation. If they had not been available, the health of consumers in eighteen communities would have been seriously endangered. Dependence cannot be placed on the availability of these chlorinators as they often are all in use. The most important point, however, is that interruptions in treatment usually occur even though the portable units are installed as soon as practicable after a failure.

The only safe answer to the problem of continuous chlorination is the installation of standby machines so that in the event of failure of one machine the other can be put into operation at once. Also, complete supply of replacement parts should be kept on hand for ready repair, and these parts should be replaced when used.

The principal chlorinator may be operated by an electric motor or water for the chlorinator may be secured from a motor-driven pump. Under these circumstances the chlorinator will fail to operate when electric power is cut off due to the effect of lightning, sleet storms, etc. Therefore, when principal dependence is placed on electricity the auxiliary or standby chlorinator preferably should be of a type which will operate without electric power, such as a hypochlorinator driven by a small gasoline engine or by water pressure. The problem of electric power failure is most acute with a gravity supply because water will continue to flow and thus will enter the system untreated.

Another desirable auxiliary arrangement is the use of a hypochlorinator as standby for a gas feeding unit so that continuous chlorination can be assured. The difference in the type of the two chlorinators generally means that difficulty will not be experienced with both units at the same time.—*New York Water Works News.*

Better Safety Practices Are Needed in Public Works

There is a wide field for improvement in effecting safe construction practices in the public works field, especially among the employees of states, cities and counties. Trenching, street maintenance and motor vehicle repair shops are a few of the places where standard safety practices can and should be much more widely applied. The first step is to work out standard practices, but the more important step is to apply them. It is not enough to make safe practices available in a printed form, nor to lecture foremen and supervisors on what they should do. Safety methods must become a routine, and until they do they will not be fully effective.

Granting that this is outside of their usual scope of work, this might be a worth-while job for our state sanitary engineering departments. In most states there are safety divisions (who normally spend much of their time on industrial work) through whom a start can be made; and in addition safety principles could be applied to the men on the job through state highway departments and in short schools and other existing training facilities for water, sewerage and highway personnel.

Sizes 60 to 600 ft., trailer, truck, tractor or skid mounted. Gas, diesel, electric.

Valves are the heart of any compressor. Jaeger's air-animated "Tough Swedish Twin" Valves are 75% to 100% larger than others to insure free air flow—so cool they operate indefinitely without carbon. "Ultra-lapping" to micro-precision finish produces perfect leak-proof closure and makes them 10 times longer-lived. Ask for Catalog JC-5, describing the most efficient 2-stage, air-cooled compressor in use today.

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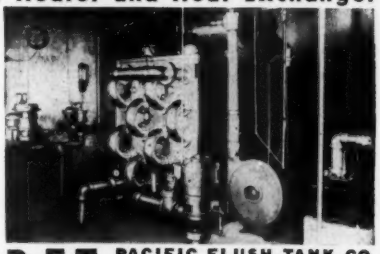

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Enclosed Equipment Not Always Weatherproof

By W. F. Schaphorst, M.E.

We sometimes erroneously believe that simply because a machine is completely enclosed it can be safely installed outdoors. Totally enclosed motorized variable speed drives, for instance, are a good example. Instances have been brought to this writer's attention of drives of this type being harmed by installing them outside, subject to year-around weather.

These drives are totally enclosed, yes, and the users doubtless felt that they would be immune to any kind of weather. But not so. When the sun shines on the casing the inside may become so hot that the belts are ruined. Then when it rains and water enters the housing, which is not watertight, the discs may be caused to stick and corrosion may result; and in extremely cold weather the discs and belts may cease to operate satisfactorily due to stiffness and congealed lubricant.

So if you find that you must install devices of this type in connection with outdoor machinery, it is well to be sure that they will be kept dry at all times and that they will become neither too hot nor too cold. In other words, a shelter is advisable. The same is true of other machinery that is generally installed indoors. Don't install it outdoors without first consulting the manufacturer.

A Tip to Makers of Household Water Filters

Helena, Mont., obtains its water from the head of Last Chance Gulch, one of the world's richest placer deposits. One of its citizens, who has a household filter screen attached to his kitchen faucet, recently removed it to clean it and found in it three small gold nuggets.

Report of this find should cause a run on Helena's providers of household filters. Also it should insure more frequent cleaning of such filters by water consumers—a duty quite commonly neglected, we fear.

Australia Adopts AASHO Bridge Loadings

Difficulty in obtaining good timber will lead to the increased use of steel and concrete, with consequent longer life of structures. With increasing traffic, it is probable that the economic axle load limit will be raised before such structures will have reached the end of their useful life. Further, with decentralization of industry, it may be necessary to carry occasional very heavy loads.

In view of these factors, the question of loadings to be adopted for the design of bridges on important roads has been considered at the last two conferences of the Senior Technical Officers of the Australian State Road Authorities. Their final recommendation that the H20-S16-41 loading of the American Association of State Highway Officials should be adopted for State Highways and Main Roads has now been approved by the Conference of State Road Authorities. —From the 1946 Annual Report of C. G. Roberts, Chief Engineer, Country Roads Board, Australia.

It Was a Noisy Centrifugal Pump

By W. F. Schaphorst, M.E.

In the writer's city there was a noisy centrifugal pump which operated with a suction lift. The engineer asked whether it would be all right to admit air into the suction.

Air admitted into a suction line sometimes does eliminate noise, but the writer does not recommend that procedure. The noise is sometimes due to the fact that the suction lift is excessive causing what is known as "cavitation" in the impeller. Air in the suction is generally bad because it reduces pump efficiency and it may also promote corrosion. In other words admission of air into the suction is a makeshift method. The preferable way is to determine the cause of the noise and then eliminate the cause. If the noise is due to excessive suction lift the pump can probably be lowered sufficiently so that the lift will be of correct height. Do the bearings rattle? If so, repair the bearings.

Long noted for mechanical strength and simplicity of construction . . .

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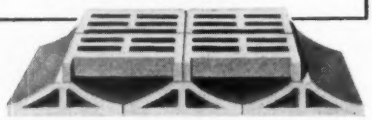
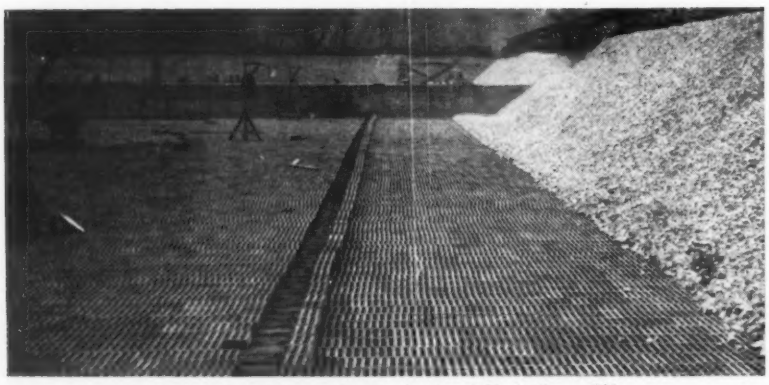


Two-Unit Trickling Filter Floor



Metro two-unit floor at Sewage Treatment Plant, Akron, Ohio

★ superior performance proved by many installations since 1926

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★ area of apertures is 40% of filter floor surface

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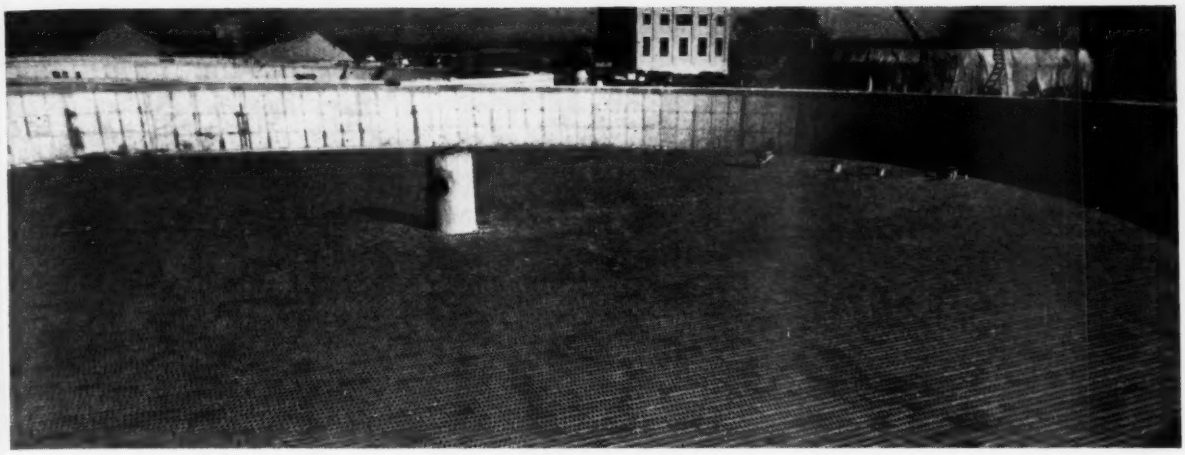


Drainage floor of a large trickling filter. Courtesy Ayer-McCarel-Reagan

TRICKLING FILTERS

Sound practice for selection and placing of trickling filter media. ASTM specifications for vitrified clay underdrains.

Media for Filters

In most cases broken stone or crushed slag are preferred for media for trickling filters, though in some cases clay media appear to have advantages. With stone or slag, the media should be sound and durable, free from dirt and fines, and properly graded. An approximately cubical shape is preferable. Durability may be tested by the sodium sulphate test, though all engineers are not in agreement that either this test, or the freezing and thawing test, is a reliable indication of the durability of stone for trickling filter service. When the sodium sulphate test is used, any media of which 10% of the number of pieces fail or the total loss of material exceeds 10% as a result of 20 testing cycles should be considered unsuitable. Where testing is not feasible, and in the case of small installations, it may be sufficient to inspect the quarry from which the stone is to be obtained; to note the condition and appearance of the source material and of the aggregate produced; and to examine other filters, state highways, and concrete made from the aggregate. Visual inspection of concrete in service for several years may help to indicate the suitability of the aggregate used. A good inspector on the job is even more necessary when aggregate is not tested.

Size of Media

There is no recognized standard size of stone for filter media, though a possible tendency appears to be toward the use of coarser stone. Common sizes are 1½" to 2½", and 2" to 3", though still larger stone is frequently used. According to the National Research Council Report, 8 of the 34 filters described used stone having a minimum size of 2½" or 3". Using the smallest dimension to designate the size, of nine low-rate filters, 4 used 1½", 4 used 2½" and 1 used 3"; of 10 deep filters with recirculation (mainly Aerofilters and Accelo Filters), 3 used 1½", 4 used 2" and 2 used coarser stone, while 1 was indefinite; of eight shallow filters with recirculation (mainly biofilters), 1 used ¾" to 1½", 3 used 1" and up, 3 used 1½", and 1 used 2".

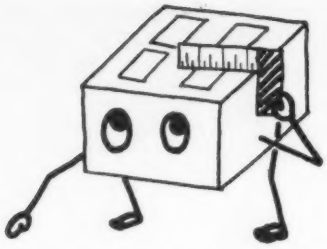
The personal opinion of the writer is that coarser media, preferably 2½" to 3½", is preferable; and he prefers to use the same size in secondary as in primary filters. Whatever the sizes specified, a tolerance of about 5% plus or minus should be the limit. Fine material, being particularly objectionable, should be clearly and rigidly restricted; generally 3% by weight should be the maximum passing a specified screen, as ½" or ¾".

Handling Stone

Probably more filters have gotten a poor start in life from careless handling and placing of stone than from any other cause. Some of the photographs in earlier sections of this series have shown methods that are not defensible. The following procedure in handling is recommended: A layer of coarser stone about 6" thick is placed on the underdrains; the remainder of the stone is dumped outside the filter and rehandled into place. This will cost more but is worth it. When hauling by truck, which is the universal practice, fine material collects in the bottom of the truck body. When the load of stone is dumped, a pocket of fine material results. A belt conveyor, with a screen feed, is excellent for rehandling. However, when a conveyor is used, stone should be spread in layers not over 2 ft. deep as coning and segregation occur otherwise; or a face should be built up for the entire depth of the filter, letting the coarser stone roll to the toe of the slope. Generally some fine material will enter the underdrains, no matter how carefully the work is done. This should be removed by flushing or other locally applicable means; but every effort should be made to minimize the amount of fine material going into the filters.

Specifications for Stone

No late specifications for trickling filter stone are available. Those used at Dallas, Tex., some ten years ago and forwarded to us by Prof. R. M. Dixon are summarized below. These were apparently satisfactory, for no unfavorable reports have been received regarding the durability of the media in these filters. The specifications: "The aggregate shall be crushed stone of a quality that will withstand the disintegrating effects of the weather and of the applied sewage. The aggregate may be granite, limestone or trap rock, and shall be of such quality as to satisfy the following: Not more than 3.7% wear; not more than 0.70% absorption; minimum spe-



cific gravity 2.60; minimum hardness 12.00; crushing strength 15,000 lbs. per sq. in.; calcium carbonate (if limestone) not less than 8.3%; sulphate as SO_4 not over 1.2%; organic matter none; loss, sodium sulphate, 20 cycles, not over 10%; and pyrites, trace. Sizes shall be as follows, using a round screen: Retained on 3" but passing 3½", not more than 5%; passing 3" and retained on 2", not less than 50%; passing 1½", not over 5%; passing 1", not over 3%. Soil and clay not permitted. Stone shall be produced by one operation of the crushing and screening unit, and recombining will not be allowed."

Clay Media For Filters

Various types of clay filter media have been employed, especially in high rate filters and for very strong sewages. Among these are the "Raschig" rings, which are hollow cylinders of equal length and diameter, with only enough wall thickness to provide strength. Another type of clay media is a block about 12" cube, which is perforated with the maximum number of 1" diameter holes. The blocks are so set, one above the other, that each hole is continuous from the top to the bottom of the filter.

Banister Engineering Co. (in a forthcoming article in Public Works Magazine) reports the use of clay media for strong sewages containing vegetable processing, milk or packing wastes. These filters are loaded to 3.3 pounds of BOD per cubic yard of media, or more than 5,000 pounds per acre foot, and recirculation may be used. An advantage of this design is that ponding is eliminated.

Specifications for Underdrains

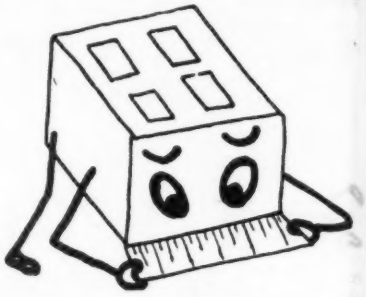
The following tentative specifications have been prepared and published by the American Society for Testing Materials, and are designated as C 159-45 T:

Scope

1. (*a*) These specifications cover vitrified clay filter block made from clay or shale or mixtures thereof. Two types of filter block are covered, as follows:

Type I.—A one-piece filter block suitable for use in constructing a single-course trickling filter floor, which provides continuous drainage channels or ducts through the lower portion of the block for the conveyance of liquids from the filter bed and drainage and aeration grilles in the upper portion of the block for the passage of liquids from, and air into the filtering media.

Type II.—A two-piece filter block suitable for use in constructing a two-course trickling filter floor, which provides drainage and aeration. When placed or assembled, a course of the lower pieces or units forms continuous drainage channels or ducts for the con-



veyance of liquids from the filter bed and for the passage of air into the filter bed. An assembly of the upper units forms drainage and aeration grilles for the passage of liquids from, and air into the filtering media.

(*b*) The purchaser should specify the type or types of block desired.

Compressive Strength

2. The average compressive strength of fine filter blocks shall be not less than

ARMCRE FILTER BOTTOM BLOCKS

- *Top Left:* Placing stone on ARMCRE filter floor at Rapid City, S. D.
- *Lower left:* Laying floor of self-aligning, light-weight ARMCRE Filter Bottom Blocks.
- *Upper right:* It is no trick to lay ARMCRE blocks. This floor is at Walteboro.
- *Lower right:* Illustrating the proper way to place stone in a filter. ARMCRE installation at Wautoma, Wis.

Hundreds of installations prove the value of ARMCRE Filter Bottom Blocks. The Standard of Underdrains.

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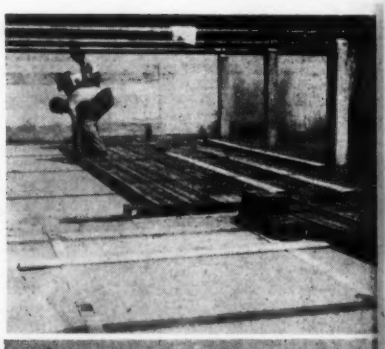
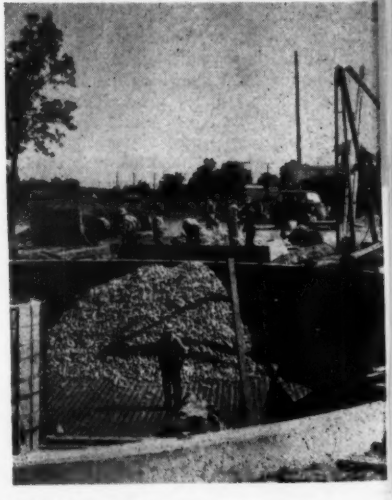
AYER-McCAREL-REAGAN CLAY CO.
BRAZIL, INDIANA





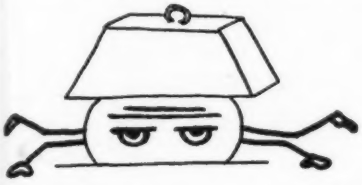
600 psi., based on the gross area of the block, with the load applied in the same direction as in service. No individual block shall have a compressive strength of less than 500 psi.

Absorption

3. The average water absorption of five filter block, by 1-hr. submersion in boiling water, shall not exceed 6 per cent of the dry weight of the block.

Shape

4. (*a*) Type I filter block shall be of the self-spacing type and shall be



rectangular in plan, as laid. When placed in parallel rows on the subfloor of the filter bed, the cells in a single course of Type I filter block shall form continuous drainage ducts, and the apertures or slots shall provide for drainage and aeration of the filter media.

(*b*) Both the units for the lower or drainage course and the units for the upper or aeration course of Type II filter block shall be of the self-spacing type and shall be rectangular in plan, as laid. When placed in parallel rows on the subfloor of the filter bed, the lower units shall form continuous drainage channels. The upper units, when laid in parallel rows on the lower units, shall provide for drainage and aeration of the filter media.

Permissible Variations in Dimensions

5. The length, width, or height of a filter block shall not vary by more than ¼ in. per ft. over or under the nominal dimension.

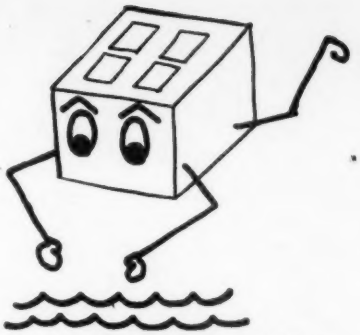
6. (*a*) Apertures in the top of Type I filter block shall be not more than 1½ in. in width, but may vary in length. The aperture area shall be not less than 20 per cent of the top area of the filter block when in position of use.

(*b*) Apertures in the top or aeration course of Type II filter block shall be not more than 1⅛ in. in width, but may vary in length. The aperture area shall be not less than 40 per cent of the top area of the block when in position of use.

Shell and Web Thickness

7. (*a*) The exterior walls (shells) of Type I filter block shall be not less than 9/16 in. in thickness and the interior webs shall be not less than ½ in. in thickness.

(*b*) The exterior walls (shells) and the interior webs and struts of the Type II filter block comprising the lower or drainage course shall be not less than 9/16 in. in thickness. The exterior walls (shells) and the longitudinal webs of



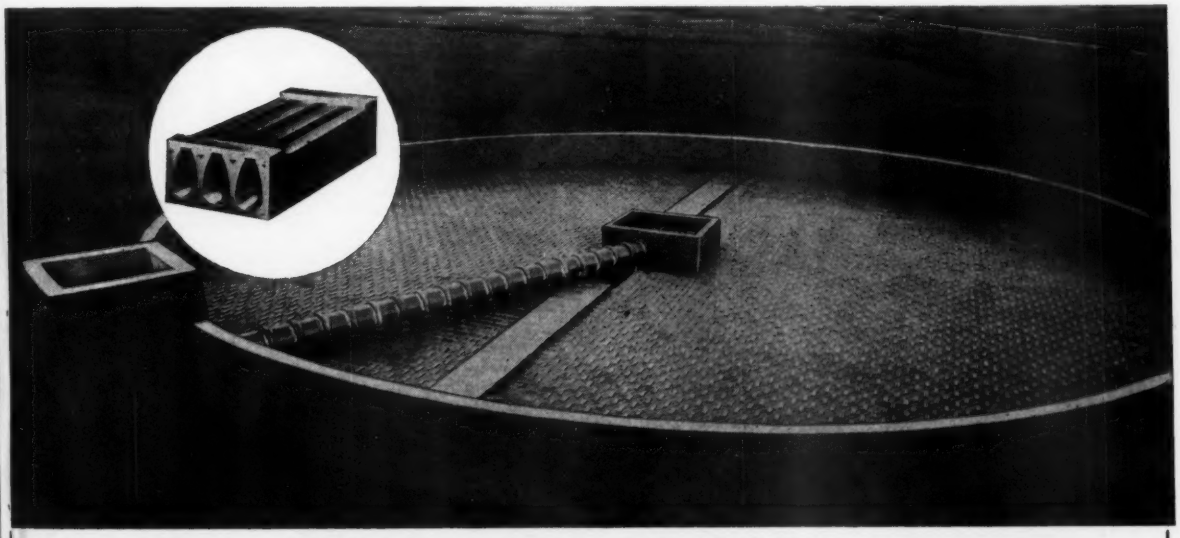
Tests for Joe Filter Block are listed on these pages.

the Type II filter block comprising the top or aeration course shall be not less than 1⅛ in. in thickness. Stiffening webs, for stiffening the longitudinal webs, shall be not less than 9/16 in. in thickness.

Drainage Channels

8. (*a*) The aggregate effective cross-sectional area of the drainage channels in a filter block shall be not less than 15 sq. in. per ft. of width of that filter block. The effective cross-sectional drainage area shall be defined and measured as the sectional area lying below the lowest level of the aperture slots.

(*b*) The cross-sectional shape of the bottom of the drainage channels of any filter block shall be curved or narrowed



NATCO UNIFILTER BLOCKS **FOR TRICKLING FILTER BEDS**

Above is one of two tanks, 90 ft. in diameter, installed at the LaChoy Food Products Division of Beatrice Creamery at Archbold, Ohio. Here Natco Unifilter Blocks of glazed, hard-burned clay, by reason of their light weight and single unit feature were rapidly and economically installed. Their great structural strength has resulted in low repair and maintenance costs. Write for literature.

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in width to form a trough in the bottom of each channel, so as to accelerate flow of effluent and to minimize stranding of solids in such channels.

(*c*) The height of the drainage channels in any filter block shall be not less than 2½ in., measured from the lowest level of the aperture slots.

(*d*) There shall be not less than two parellel drainage channels per foot of width of a Type I filter block.

Workmanship and Finish

9. (*a*) Filter block may be either glazed or not glazed, unless otherwise specified in the purchase order.

(*b*) The lower bearing surface of filter block shall not vary from a plane by more than ⅛ in. per ft. of the greatest length or width of the block.

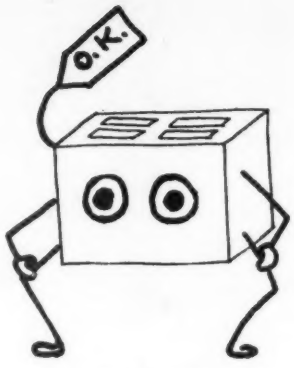
(*c*) All filter block shall be well burned and substantially free of laminations and fractures. All block shall be free of cracks exceeding 2 in. in length, of chips exceeding 2 by 1 by 3/16 in. in dimensions, and of blisters exceeding 2 in. in diameter and projecting more than ⅛ in. above the normal surface.

Marking

10. All filter block shall bear the name, initials, or trade mark of the manufacturer. These marks shall be indented on the exterior of the block and shall be legible.

Rejection

11. If the test specimens fail to conform to the requirements for compressive strength or absorption, the manufacturer may sort the shipment, and new samples shall be selected by the purchaser from the retained lot and tested at the expense of the manufacturer. In case the second set of test specimens fails to meet the requirements, the entire lot shall be rejected.



Joe Filter Block Passes.

12. Except as specified in Section 11, the expense of inspection and testing shall be borne by the purchaser.

Sampling and Testing

13. (*a*) The purchaser or his authorized representative shall be accorded proper facilities for sampling and inspection of the filter block, both at the place of manufacture and at the site of the work. At least ten days from the time of sampling should be allowed for completion of the tests.

(*b*) Filter block shall be sampled and tested in accordance with the Standard Methods of Sampling and Testing Structural Clay Tile (A.S.T.M. Designation: C 112) of the American Society for Testing Materials.

Specifications for Laying Underdrains

The following specifications for laying vitrified clay filter underdrains have been suggested by the Trickling Filter Floor Institute and are based on considerable experience in this work:

The filter blocks shall be laid in place on the floor of the trickling filter and in longitudinal rows running at the desired angle to the drainage channels. The blocks in each row shall be laid in true alignment and with the cross joints staggered in each row by starting every other row with a fractional length.

The filter block may be laid and imbedded in a dry cement-sand bed mixed in proportions of one of cement to six of sand. The entire surface should be sprayed or sprinkled with water after the block are laid so that the cement-sand bed will take a set before the filter media is applied.

This method using a sand-cement bed is recommended as it avoids the floating of the block in the grout, gives

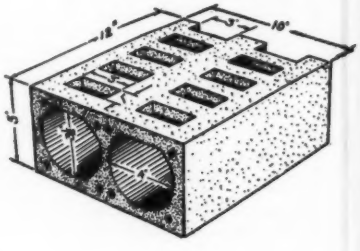
ARMCRE FILTER BOTTOM BLOCKS BY BOSCO

For Better Trickling Filter Operation

Trade Mark Reg. U. S. Pat. Office

Proved by performance in hundreds of sewage disposal plants, ARMCRE Filter Bottom Blocks meet all requirements for completely successful underdrain construction.

More than 26% of top of each block is used for rectangular openings, permitting air to circulate freely and maintain ideal aerobic conditions. Entire inner surface of ducts is smooth. No solids accumulate in an ARMCRE system.



Special Features:

One of the easiest blocks to lay.

Made of highest quality de-aired Vitrified Shale and Fire Clay.

High compressive strength.

High resistance to acid or chemical action and deterioration.

Exceptional aeration and drainage features.

Easy to work over after laying.

App. Dimensions and Weights

Full Block: 12" long, 10" wide, 5" high.

Ducts: Each 4" wide by 3½" high; Cross-sectional area per duct, 12.5 sq. in.

Top Openings: each 3" long by 1" wide.

Weight per Block: 20 pounds. Weight per square yard of floor: approx. 240.

Other BOSCO Products

BOSCO *Extra-Quality* Drain Tile and Fittings
BOSCO Plain End Pipe and Tru-Line Collars
(Plain and Perforated Pipe)

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Complete Service Ohio and East

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Drainage Material Specialists

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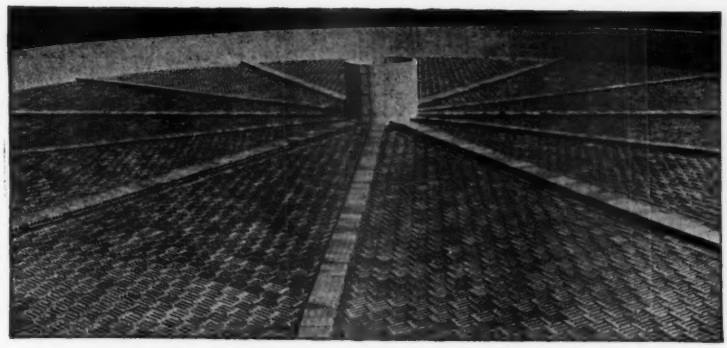
a more uniform surface, and has been found to be a cheaper method of construction.

Design Details For Filters

General Layout.—On circular filters up to about 200 ft. in diameter, the simplest layout is to pass the central drain channel through one diameter and slope both halves of the filter toward the center channel. On deep filters where the feed pipe is not far below the surface of the stone, the center channel can pass through or around the center pier. On shallow filters, where the feed pipe normally passes under the filter, the center channel must pass around the pier or the channel must be offset from the center line. Where the offset method is used, provision must be made for adequate drainage around the pier. With a rectangular filter of moderate size, the same central channel arrangement may be used. With very large filters, two or more drainage channels may be desirable.

Shape of Filter.—With a rotary distributor, the circular form is simplest from the viewpoint of construction. Circumferential reinforcing carries the stresses and the walls need not be stable against overturning though they are often designed to be so. A thin wall and relatively small footings may reduce the cost. If the wall is not designed to be stable, care should be taken not to backfill on the outside before the media is placed inside; and placing of the media should be relatively uniform over the whole filter area. Octagonal filters have been used, but appear to have few advantages under present day construction conditions.

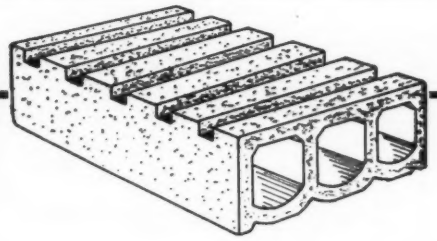


The underdrains of this 36' diameter filter are laid in segments sloping to the center.

Ventilation.—Actual data regarding the necessity for ventilation are meager. It is generally recognized that the presence of air in the interstices of the filter is necessary all of the time. How much air is necessary and how its presence in the filter can best be assured are not matters of agreement among engineers, nor is there any common practice. In general, it may be assumed that good construction, as outlined in these articles, will provide adequate ventilation in both high-rate and low-rate filters.

Ventilation may be improved by extending the underdrains through the filter wall by means of special wall ducts or reducers; or the underdrains may be stopped about 6" from the wall and covered with a special block or half tile, with risers of vitrified pipe spaced at intervals around the periphery of the filter.

The concluding article in this series will appear in an early issue.



TRANSLOT

The Efficient Filter Block with the Transverse Slot

TRANSLOT blocks are made from Vitrified Clay, the EVERLASTING and ACID PROOF material. Its Salt Glazed, smooth walls permit the rapid flow of sewage.

Transverse Slots across the top of the block provide properly proportioned openings into the ducts for collecting downward flow of liquids and the upward passage of AIR.

Lengthwise grooves on under side of each block hold alignment when laying. Uniform in size, 6 blocks cover a square yard of filter floor. Self aligning and self spacing, they are easily and rapidly laid on 1 foot centers. Translot, made with standard fittings, can be used on all types and designs of Trickling Filter Beds.

TRANSLOT ADVANTAGES Include:

1. One piece—easy to lay.
2. Made from vitrified clay and salt glazed.
3. 12" wide and 18" long—easy to figure.
4. Cross Ventilation betwen ducts made possible by transverse slots.
5. Furnished with all shapes—Manufactured to your plans.
6. Properly proportioned apertures provide thorough ventilation and rapid run off.
7. Close dimensional tolerances and carefully inspected.
8. High in compressive strength—Low in absorption.

Send your plans and let us submit estimates of quantities and prices.

Cannelton Sewer Pipe Co. CANNELTON, INDIANA

PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

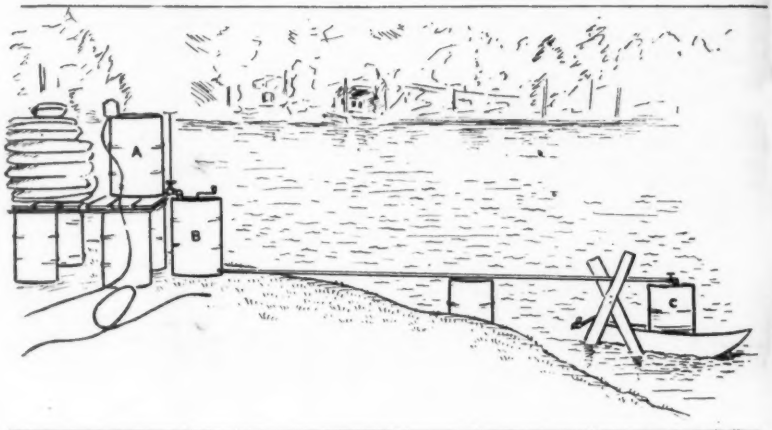
The letter and number at the end of each item refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Waterworks Digest

Activated Carbon For Open Reservoirs

Tastes and odors were eliminated from the pond of 108 acres that furnishes the supply of Pembroke and two other Massachusetts towns by use of activated carbon without subsequent filtration. Copper sulfate applied at 3 ppm was ineffective, so sulfate followed by activated carbon was tried, both applied from motors; copper sulfate at the rate of 0.6 ppm, and carbon at 1.25 ppm. The next morning no taste, odor, turbidity or carbon was found in tap water. The screens in the pump well were covered with a gelatinous mass flecked with carbon, which was washed off at half-hour intervals. A gelatinous mat ½" thick composed of amorphous matter covered the bottom of the pond. Chlorine consumption dropped 3 to 4 lb. per mg. The trouble did not return, but just before ice formed, 0.4 ppm of copper sulfate and 1.25 ppm of carbon were applied as a precaution.

The carbon was applied in a water suspension, piped to containers in the motorboats from a filling station on land, where it was mixed in a barrel by means of an electrically driven centrifugal pump. From the boat the suspension was discharged through a 1" copper service pipe carried up over the stern and terminating in the wash of the propeller.[B18]



Courtesy New England WWA

Diagrammatic sketch showing general layout of carbon treatment plant.

Suggestions Of a Contractor

A member of a firm of contractors which has been building waterworks structures for many years offered the New England Water Works Assn. a number of practical suggestions which were highly appreciated. They applied chiefly to handling ground water, and concrete and brick construction. Construction of intakes, reservoirs, and filter plants, as well as deep pipe lines, often extends below ground water level, and bids will generally be lower if the bidders are furnished information obtained by core borings not over 50 ft. apart over the entire area involved. If the soil at the bottom allows free passage of water, the use of the well-point system will reduce construction cost. But if the soil is dense, it is not practicable. It is a waste of money to purchase well-point equipment; it is cheaper to rent the equipment. The operation of it requires hiring four men for 24-hr. operation 7 days a week, costing about $250 a week. Whatever the cost, it will be less than that of the sheathing alone, in the case of trenches, and will reduce the other expenses. If the job is large enough to warrant the use of 8" pumps, a Diesel pump is most economical, using 35 gal. per day of oil against 150 gal. of gasoline for a gasoline engine. In one case where the excavation covered 3 acres, the area was drained by pumping from two pump wells ten feet deep, formed by oil drums punched full of holes and surrounded by 3 or 4 ft. of crushed stone. If the bottom of the excavation is fine material, sheathing and sump pumping is probably necessary, but the hydrostatic head can often be lowered by means of well points in the upper porous soil.

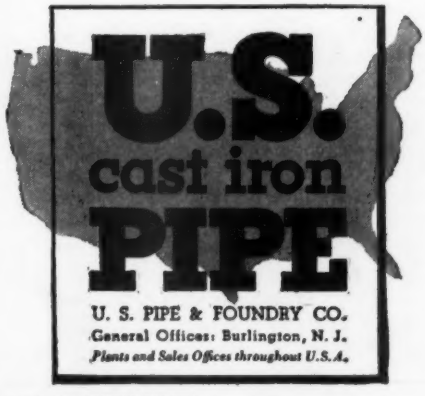
In building concrete walls, he recommended use of steel plate as water stops in construction joints instead of copper; the latter often is bent out of shape when pouring the concrete, and costs more. In designing a circular well, do not batter the wall; the cost of sheathing for a battered wall will exceed that for one of uniform thickness by several times the cost of the concrete saved.[B21]

Swedish Water Treatment

A Swedish engineer, comparing Swedish and American water treatment practices, finds differences in local conditions responsible for most of the differences in practice. In Sweden most of the supplies are surface water. There are only three softening plants. Zeolite treatment is not used there. On the other hand, they consider the Swiss Magno compound superior to any American practice for removing CO_2.

Original Woodcut by Lynd Ward

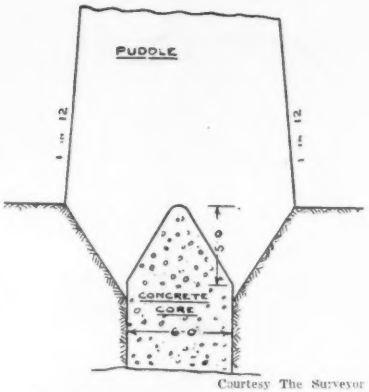
The life of a supply line, to be constructed with cast iron pipe, is obviously more predictable than the future growth of the community it is to serve. City planners may hazard a prediction of population growth in a hundred years. Water works engineers can predict, on the basis of proved service records, that a properly constructed cast iron supply line will have a useful life of *more* than a century. A substantial part of the tonnage of large diameter cast iron pipe, installed for supply lines throughout America, is U. S. Cast Iron Pipe.



iron and manganese, and the Swedish Inka apparatus superior to our aeration equipment for removing CO_2. They widely use separate circulation of swimming pool water for chlorine dosage. In sterilizing water for domestic consumption the U. S. has a long lead over Sweden. The chief lead is in details of design and understanding of the relation between the technical development and its economic importance.[A81]

Grouting the Foundation Of an English Dam

The plans for the Darwell impounding dam at Hastings, England, now nearing completion, called for a central clay puddle core wall. Borings had indicated that the foundation would be entirely in clay, which lies on a stratum of water-bearing sandstone. The dam is 1,878 ft. long; maximum height, 59 ft.; maximum width at base 500 ft. The trench for the foundation was carried down to depths as great as 50 ft., and had been excavated for more than half the length of the dam when it unexpectedly ran into an intrusion of the sandstone only a few feet below the surface, from which water entered the trench at the rate of 1,000,000 gal. a day. This required an entire change of plan. It was decided to endeavor to form a cutoff in the sandstone by grouting, and to make the core wall of concrete up to the level of the surface, and clay above that. Boreholes were sunk at 20 ft. intervals throughout the length of the



Courtesy The Surveyor

Junction of top of concrete core and clay puddle core.

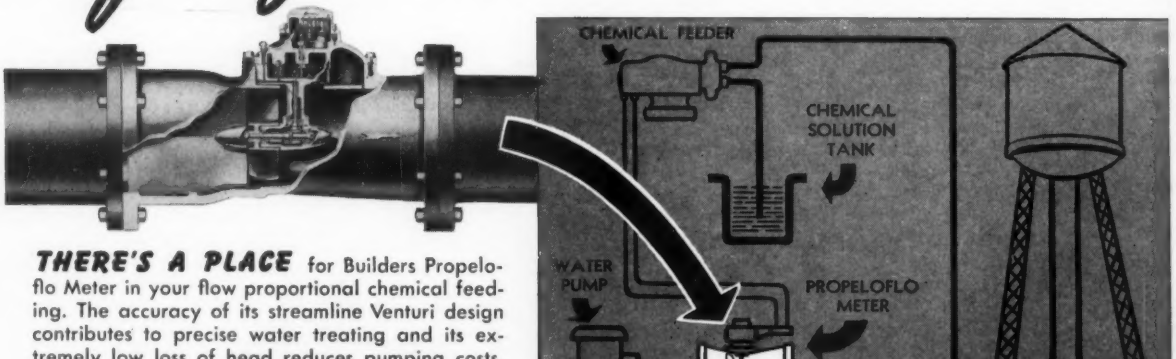
core wall and to depths up to 130 ft. and lined with 5″ steel pipes, which were carried up through the core. Every fourth borehole was pressure-grouted with cement until grout appeared at a neighboring borehole or at the ground surface. Where it seemed necessary, intermediate holes were bored and grouted. The effect of this grouting on water level in observation boreholes up and down stream was recorded daily, and as grouting proceeded the uniformity between them decreased. When the reservoir was filling with water, water levels in the boreholes upstream were affected but levels in those downstreams were not. Springs in an outcrop of the sandstone below the dam diminished in flow. More than 5,000 tons of cement was used in the pressure grouting.

To secure watertightness of the core wall where concrete and clay meet, the concrete was given a steep-sided curved nose and the adjoining ground at each was sloped so that, when the inevitable sinking of the puddle clay takes place, it will tighten up in the wedge-shaped spaces so formed.[D3]

Submerged Pipe Lines at San Francisco

Most of San Francisco's water supply comes from the other (eastern) side of S. F. Bay, which extends SE from the ocean to a point about 25 miles from the city. In 1888 two supply lines of 16″ wrought iron pipe were laid across a neck of the bay about a mile wide. These pipes were galvanized and dipped in a combination of asphalt and coal tar, and were in excellent condition when examined 48 years later. In 1901 two lines of 22″ Bessemer steel pipe were laid across the bay parallel to the others. In 1925 a line of 42″ c.i. pipe with ball-and-socket joints was laid near the others on a layer of crushed rock in a trench in firm clay. This also has given no trouble; but a part of this line 405 ft. long was laid in a slough on a bottom of soft mud and has kept moving out of line and opening up at joints in spite of driving piles and dumping crushed rock along it. After three re-

Propeloflo PACES PROPORTIONING PUMPS



THERE'S A PLACE for Builders Propeloflo Meter in your flow proportional chemical feeding. The accuracy of its streamline Venturi design contributes to precise water treating and its extremely low loss of head reduces pumping costs. The Propeloflo Meter bolts into any line from 2″ to 36″ as easily as a short length of pipe, reads directly in gallons, and has ample power to operate a variety of feeding controls. Paced by Propeloflo, chemical feeding is correct—without wasteful overfeeding or dangerous underfeeding. Hydraulic control, without electricity, air or other source of power makes chemical feeding as dependable as the flow itself.

For Bulletin 350A, address Builders-Providence, Inc., (Division of Builders Iron Foundry), 16 Codding St., Providence 1, R. I.

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Venturi, Propeloflo and Orifice Meters • Kennison Nozzles
Venturi Filter Controllers and Gauges • Conveyoflo Meters
Type M and Flo-Watch Instruments • Wheeler Filter Bottoms
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pairs and a fourth break, in 1943 a 36″ welded steel line was installed inside the 42″ pipe and the annular space between them was filled with grout pumped in under pressure. No further movement has yet occurred. In 1936 a pair of 54″ steel pipes were laid across the bay on a submarine wooden trestle, the pipe being ¾″ plate in a 6″ concrete jacket. This has given no trouble. It is now proposed to add a 72″ line, but to carry it around the south end of the bay on dry land. This will add about 14 miles to the length but will eliminate the dangers and difficulties of repairing connected with submarine lines and will traverse districts where additional consumption may develop.[E18]

Financing Waterworks

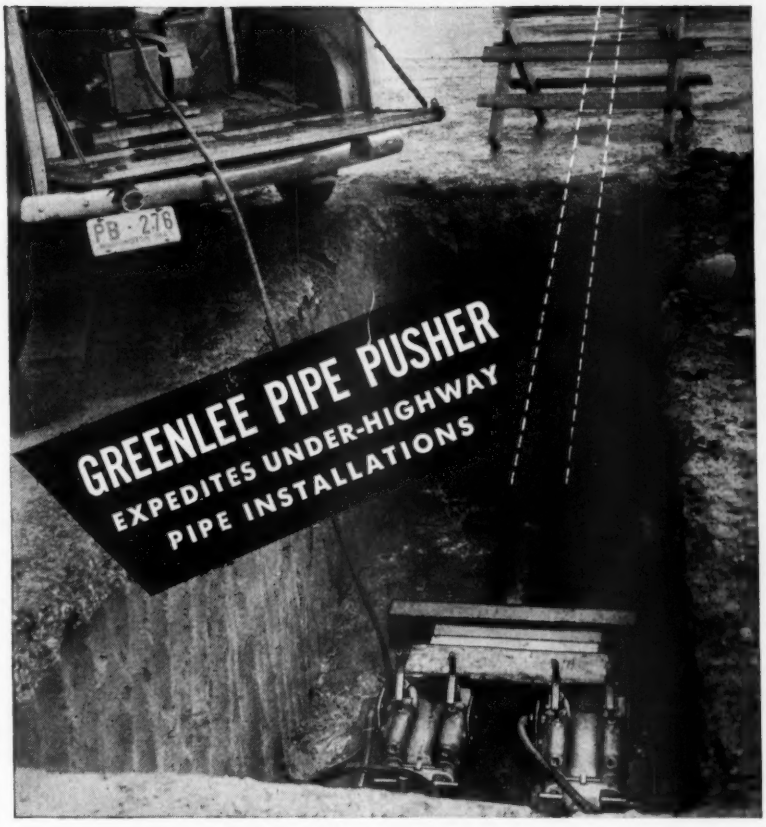
Financial soundness and maximum efficiency require a well-managed plant and proper allocation of revenues to permit a pay-as-you-go policy wherever possible. When borrowings are necessary, however, expert services should be engaged to determine the economic soundness of the project, obtain community support and prepare an informative prospectus that will impress the bond buyers and secure the lowest financing costs obtainable for the community. When such precautions are taken, the water works executives will be able to plan carefully and wisely, construct well, and pay promptly.[A86]

Charges for Fire Protection

In Indiana, public fire protection is paid for in most cases by fire hydrant charges, which vary from $2.50 to $100 per hydrant per year. This method is unscientific, encourages the use of an inadequate number of fire hydrants and has other objectionable features. Opinions differ as to the percentage of the total cost of service that is due to provision for fire protection, this varying from 80% for small communities to 20% for large ones. What is generally considered the most equitable method yet devised, is a charge per inch-foot of the pipe distribution system, with a nominal allowance per hydrant for maintenance. In Indiana cities where this method obtains, the hydrant charge varies from $10 to $15 per hydrant and the balance is apportioned over the distribution mains of 6″ diameter or larger.[A87]

Bactericidal Properties Of Chlorine Dioxide

Studies made to learn whether chlorine dioxide might not be useful for disinfection as well as for increasing palatability led to the conclusion that, on the basis of O T A residuals, its bactericidal properties are as great as, if not slightly greater than, chlorine. With waters not artificially contaminated, less chlorine than chlorine dioxide was needed to kill, but the reverse was true in the presence of high concentrations of peptone. In contrast to chlorine, the



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efficiency of chlorine dioxide is relatively unaffected by pH values between 6.0 and 10.0, which would indicate important applications in waters of high natural alkalinity, those treated to prevent corrosion and softened waters.[A83]

Character of Reservoir Water During Filling

Quabbin reservoir, of the Boston, Mass., water supply, with an area of 38.6 sq. mi. and an average depth of 51 ft. and maximum 148 ft., began filling in August, 1939, and was filled by the spring of 1946. The bottom, to an elevation above the shore line, had been cleared but not stripped of top soil. During this time analyses were made, at regular intervals and at depths of 10, 30, 50 ft. etc., of the temperature, turbidity, color, pH, iron, manganese, dissolved oxygen, hydrogen sulphide and bacteria. The color increased slightly the second year, decreased rapidly the third and fourth, and slowly thereafter; is now 12 ppm and decreasing.

The mineral salts, such as iron and manganese, in line with the color, increased the second year but there was a vast improvement the third and fourth years (1942 and 1943). The contents of both iron and manganese have remained approximately the same in the bottom water since 1943, while at the surface the iron content continues to decrease. Manganese has not appeared within 30 ft. of the surface since 1943 nor above the 50-ft. level since 1944.

The dissolved-oxygen content fell to zero, or nearly so, in the lower regions of the reservoir, during summer and fall stagnation periods the first three years, but has not been below 29% saturation since 1942. The average at the bottom has been above 80% saturation at Station 202 and 60% at Station 206 since 1943.

Hydrogen sulphide was present in the lower regions of Quabbin reservoir the first three years, during the summer and fall seasons. There has been no hydrogen sulphide present since 1942.

In general, Quabbin reservoir improved rapidly the second and third years—in 1941 and 1942. After 3½ years of filling, the results of analyses showed that a relatively stable condition had been reached, although sigfinicant improvement in quality continues to date. Quabbin reservoir has now reached an age where it should be governed more by its own deposits than by the original bottom soil.[B22]

Corrective Treatment For Corrosion of Pipes

The value of corrective treatment with alkali for corrosion rests upon the constant maintenance of the pH at the calcium carbonate equilibrium point, 7.9. In Baltimore, prior to 1944, iron and lime treatment was used except during Sept., Oct. and Nov., and the pH averaged 7.8 for the nine months of use and 8.3 for the other three months. During treatment, the deposition of lime was sufficient to retard corrosion in the first two of the five distribution zones. After the second zone the water passes through a series of reservoirs, where some CO_2 is absorbed and the pH falls to 7.7 in the third zone, 7.6 in the fourth, and 7.5 in the fifth. In the last two, the rust coating deposited is porous, and soluble iron averages 0.25 ppm in the fourth zone and 0.40 ppm in the fifth; as compared to 0.05 in the first. Sufficient alkalinity was present, however, to prevent "red water" complaints. Once equilibrium had been established in a given zone, the pH at all points in the zone equaled that of the water entering it. Averaging over the 25 year period of corrective treatment, the cost, including labor, storage and depreciation, has been 43.1 ct. per m.g.[P19]

Anabaena and Copper Sulfate Treatment

During the fall of 1946, Kenoza Lake, a source of Haverhill's water supply, exhibited an unusually stubborn resistance to copper sulfate treatment. For years, routine microscopic examinations of the water have been made monthly during December to March and semi-monthly during the other months. On Aug. 13, 1946, Anabaena were found in moderate numbers and the lake was treated with copper sulfate at the

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rate of 2 lb. per mg. The count was moderately low in a sample collected on Sept. 5 but which was not analyzed until Sept. 9. The same was true of a sample collected Oct. 1, but there were complaints of tastes and odors. It is believed that the delay in testing the samples, while in transit to the laboratory, permitted the Anabaena filaments to be broken up so that it was difficult to detect the individual cells. On Oct. 8, 2 lb. of copper was applied, 3 lb. on Oct. 15 and on Oct. 19, and 5 lb. on Oct. 21, but these did not destroy the organisms. Chlorine doses were increased to 1 ppm but did not cure the taste and odor. High counts continued, and during Nov. 9 to 13, a copper sulfate solution was sprayed over the lake at the rate of 13½ lb. per mg and by Nov. 25 there was a marked reduction in the count, but Anabaena were still present and on Dec. 9 to 11 another dose of 13 lb. per mg was applied by spraying and by Dec. 16 the organisms were practically eliminated. Lessons to be learned by this experience are the importance of frequent samplings and prompt examinations of them; the copper sulfate should be used as a preventive rather than a corrective measure and applied promptly when needed; too much is preferable to too little; and particular vigilance should be exercised during prolonged dry periods with more than usual sunshine.[B17]

Effects of Sewage and Fertilizers on Algae Growths

Study of the causes of excessive growths of algae in the lakes in and below Madison, Wis., showed that the city's sewage treatment plant, which discharges into Lake Waubese, contributed 75.3% of the lake's inorganic nitrogen content and 87.6% of its inorganic phosphorus. Agricultural drainage from lands surrounding the lakes contributed approximately 4,500 lb. of nitrogen and 255 lb. of phosphorus per sq. mi. per year. The agricultural drainage from one sq. mi. was found to be equivalent to the biologically treated wastes of 750 persons on a nitrogen basis, or of 212 persons on a phosphorus basis.[B16]

Legislative Protection For Ground Water

The Indiana legislature has just adopted an act to conserve and protect the ground water resources of Indiana, and to require a permit for the use of such waters for air conditioning and cooling purposes." This act makes it unlawful for anyone to remove more than 200 gpm from the ground and use it for air conditioning or cooling unless it is cooled and re-used, or is returned to the ground through recharge wells, or a permit is secured from the Dept. of Conservation. No water shall be returned to the ground which has been exposed to the atmosphere or is not considered by the State Board of Health to be safe from a public health standpoint. Permits for withdrawal will be refused only when the Dept. has obtained conclusive evidence that such withdrawal will be "injurious to the public health and welfare of the community."[A77]

Break Point Chlorination

In 1939 not a single operator was knowingly using break-point chlorination; in December, 1946, it was in use in more than 370 plants. Meantime it has been learned that this process is useful in destroying tastes and odors, improving coagulation, in aiding aeration and manganese removal, and killing algae and bacteria. If the water is relatively free from pollution, free available chlorine can be obtained with doses of chlorine averaging 2.0 ppm, although special conditions may require as high as 100 ppm or more.[B19]

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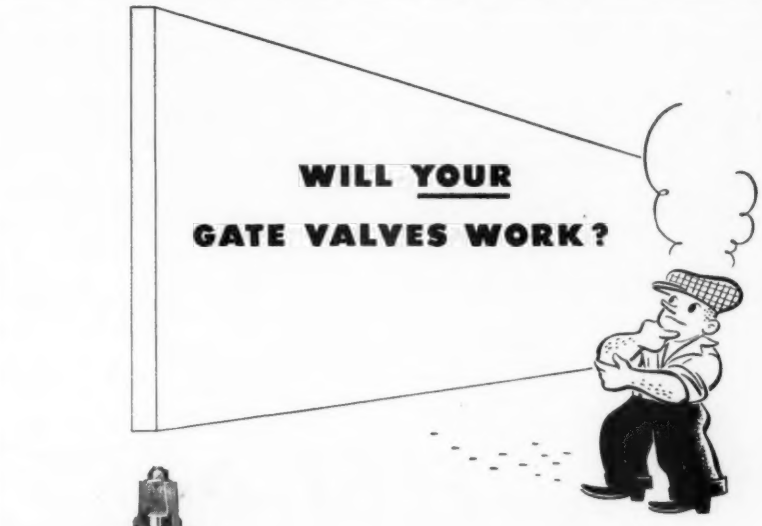

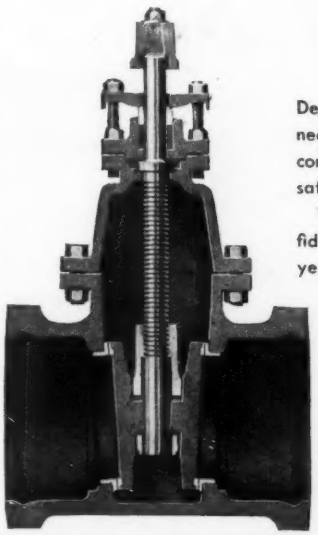

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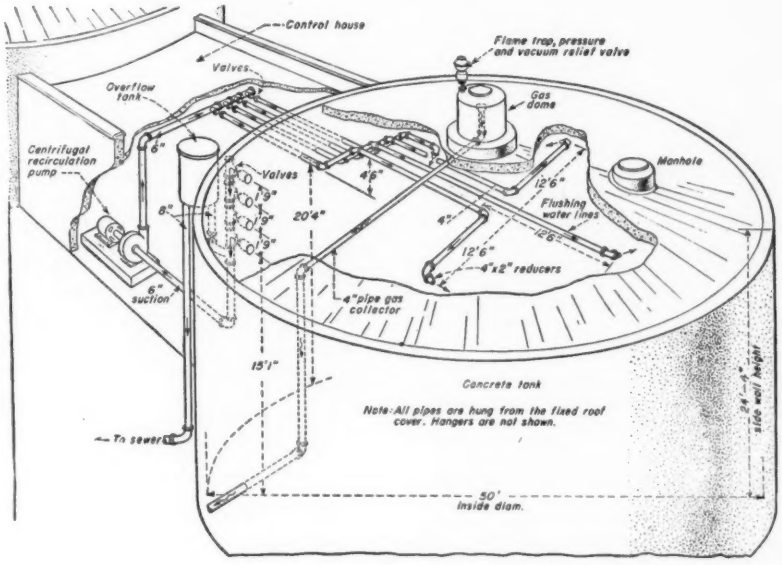
The Sewerage Digest

Controlling Digestion Tank Scum

Thick masses of solid scum in digestion tanks reduce effective tank capacity, obstructs escape of gas to the dome, and interfere with operation of heating coils. To prevent this, the scum particles must be kept moist and thin, maintained at optimum alkalinity and temperature, and constantly saturated with digesting organisms. The author's plan for effecting this is shown by the illustration. Warm liquor is withdrawn from beneath the scum and discharged on top of it through nozzles located midway between center and wall of tank and discharging tangentially 45° below the horizontal. This construction also permits heating the tank by passing the liquor through heat exchangers before it is returned to the tank. Operation for one hour each day should be ample.[E8]



Courtesy Eng. News-Record

Piping and pump installation to facilitate control of scum formation in a sludge digestion tank.

Sludge Incineration

The first permanent installation in the U. S. for incineration of sewage sludge was at Dearborn, Mich., in 1934. In 1946 there were 44 plants, 15 for flash drying and 29 multiple hearth. Fourteen of these—10 flash driers and 4 multiple hearth—have been installed since 1939. Of the 39 communities in which these plants are found, 16 have between 20,000 and 50,000 population, 6 have between 50,000 and 200,000, and 8 over 200,000 population. Three have less than 10,000 population—one only 500.

One of the difficulties in operating an incinerator is the variations in tonnage and moisture of the sludge handled. With two or three exceptions, all incinerators burn sludge dewatered on vacuum filters, and the efficiency of these filters in delivering a cake of uniformly low moisture content is an important factor in the operation of an incinerator.

The average cost of constructing an incinerator varies from $2,000 per ton for a 10-ton plant to $450 for a 1,000-ton plant; but type of plant, whether conveyors and ash-handling equipment are included, and moisture and volatile content of the sludge, may cause variations of as much as 25% from these averages. To this must be added the cost of the enclosing building, which will probably be 25 to 50% of that of the equipment. Operation costs are difficult to learn; the author found only 7 plants where they were available. Of these, the cost per ton of dry solids averaged $3.71, ranging from $5.50 to $1.12. Comparing costs of sludge and of garbage incineration, equipment for the latter costs less than for the former —about 33% as much for a 10-ton plant, 50% for a 50-ton, 53% for 100-ton, and 97% for a 1,000-ton; but the operation and maintenance costs are less for sludge incineration. Sludge has a fuel value of 10,000 to 12,000 B.t.u. per lb. of dry combustible, and this usually falls in the range of 30 to 80% of the sludge if raw or 40 to 60% if digested; giving a heat value of 10 to 30% if the moisture content be considered. Supplementary fuel required for incineration in ten plants varies from 16 to 530 B.t.u. per lb. of cake; ten times as much for digested sludge as for raw. But digesting sludge supplies gas which contains much more heating value than the difference.

In general, it can be said that raw plain settled sludge can be incinerated without supplementary fuel; in fact, an excess of heat is usually available. Incinerating raw activated sludge requires supplementary fuel. Digested sludge may or may not require supplementary fuel, depending on the degree of digestion and the moisture content of the cake. The power required to operate a plant averages 69 kwh per dry ton for flash driers and 20 kwh for multiple hearth.

Digesting sludge gives a sludge for incineration more uniform in quantity and quality. Vacuum filtration costs two to three times as much as incineration; the combined costs of the two are estimated to be a minimum when the filter produces a cake of 70% moisture, and are not much greater at 85%, which can be attained without filtering. Preheaters to increase thermal efficiency do so at the expense of ruggedness and simplicity, and at the Minneapolis-St. Paul plant the removal of them resulted in an annual saving of $6,000 a year. Garbage can readily be burned with the sludge; adding it direct to the incinerator instead of to the sewage would be the much more economical method. Drying sludge for fertilizer instead of burning it may or may not be economical. Of the 15 flash drying plants, 7 are used for drying only and 5 as either driers or incinerators.[C50]

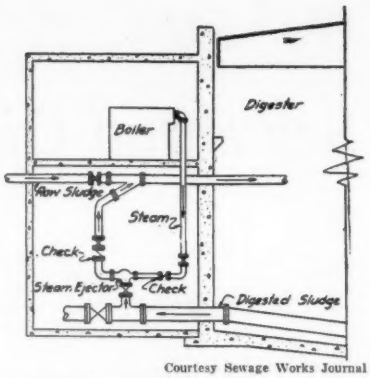
Removing Sludge From Drying Beds

At the Urbana-Champaign treatment plant are 17 sludge drying beds which had been equipped with an industrial railway system for removing the dried sludge. Two trains of three ¾ yd. dump cars were used to haul the sludge to a truck which hauled it to a stock pile ¼ mile away. Cleaning the beds

required at least 4 men to load the cars, one to drive the cars and one to drive the truck. With the scarcity of labor in 1944, some plan which used less labor seemed desirable, and several were investigated. The only two which seemed practicable were the "side-bin" tractor, and trucks. The former is used at Springfield, Aurora and Decatur, Ill., and Mansfield, O., which reported it to be successful and economical. The tractors used are 30 hp.; a 1½ yd. bin is slung on each side; when fully loaded, the tread pressure on the sand is only 9 to 10 lb. per sq. in. Its rate of travel is only 6 to 10 miles per hour. A truck can be used for longer hauls than a tractor, but a runway into the beds must be provided. The truck would have many other uses when not hauling sludge. At 1944 prices a tractor with side bins would cost $3,200 and the total annual cost would be $380. A truck would cost $1,860 and the annual cost would be $320. On the basis of this comparison, it was decided to purchase a truck, its special advantage being its usefulness for other purposes about the plant.[C63]

Injecting Steam Into Digestion Tanks

For the past two years, sludge digesters of Denver's treatment plants have been heated by direct injection of live steam into the applied sludge as it enters the tanks. Steam ejectors draw digested sludge from the bottom of the tanks and this, combined with the steam, is discharged into the raw sludge as it enters the tank at about mid-depth. With a boiler capacity of 1,000,000 B.t.u. per hour, sludge is circulated at the rate of 50 gpm. This immediately seeds and heats the raw sludge charge and makes possible the maintenance of uniform temperatures in the desired range throughout the digester. Some of the tanks had previously been heated by means of hot water coils, and about 25% of the contents in the center of the tank had a temperature lower than that at the circumference, at times by as much as 20°. Since injecting steam, the reduction in volatile matter has increased from 56° to 58° although the digester loading has increased 25%. Also the scum blankets that formerly formed have entirely disappeared.[C62]



Courtesy Sewage Works Journal

Diagram of direct injection of live steam for heating digestion tanks at Denver.

Ponding Paper Mill Wastes

A plant in Virginia discharging 8 mgd into a stream whose flow falls as low as 200 cfs has greatly improved conditions in the stream by ponding. The most polluting wastes were discharged into a pond during the low flow of summer, and this was emptied gradually into the river during periods of high stream flow and low water temperature. The amount of wastes so ponded was increased until, in 1945, it amounted to 500 gpm, which was about 10% of the total waste, containing about 40% of the total mill pollution. During a 4-month ponding period the oxygen demand of the ponded wastes was decreased 35.2%; the pH dropped from 11.0-11.5 to 8.5-9.0; the five-day B.O.D. decreased 21.8%; the total suspended solids 81.1%; total dissolved solids 17.4%; and total solids 21.7%. But the main factor in the benefits obtained was that these materials were collected during periods of high water temperature and low flow and were discharged when temperature was lower and stream flow higher. To further reduce the 60% of the total load entering

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the river, in 1946 the evaporator condensate effluent was added to the ponded fraction. This condensate amounts to only 5% of the waste water but contains 22.4% of the pollution load. With this added, 61% of the pollution was ponded, although the amount of liquid was only 12.5% of the total. It is now proposed to pond separately the remaining less polluted discharge for a few weeks, during which the high temperature at which it leaves the mill will be reduced, thus reducing the biochemical activity; suspended solids will be deposited before reaching the river; and the final outflow will be a relatively homogeneous and partially stabilized mixture rather than the present variable concentration.[C56]

Effect of Phosphates In Dewatering Sludge

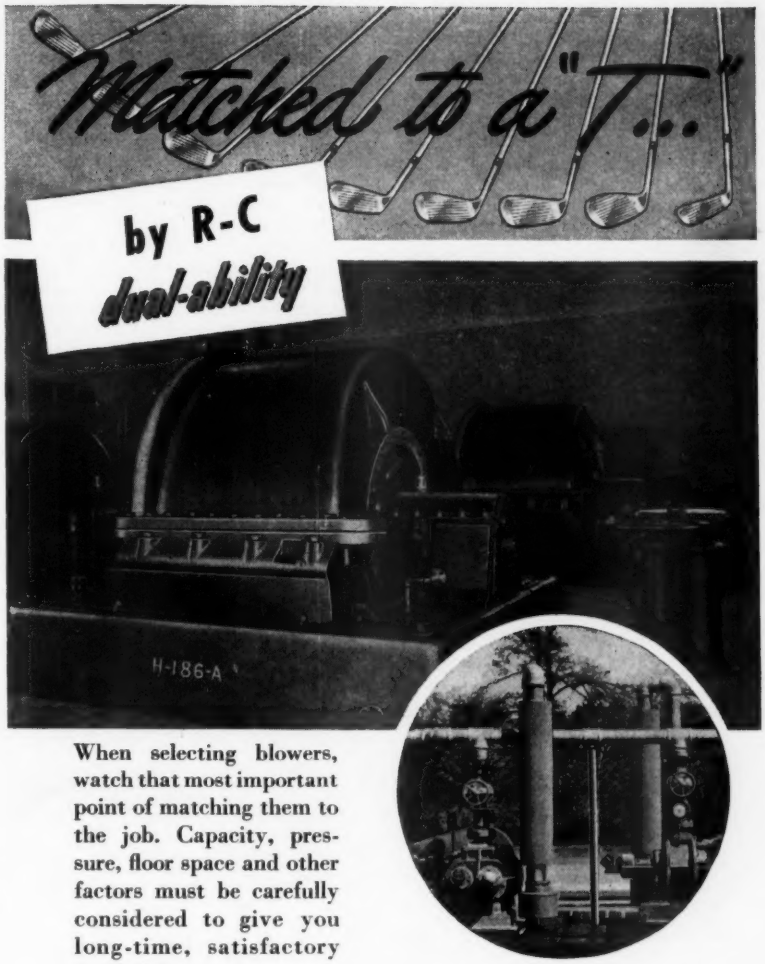
Phosphates are a normal constituent of domestic sewage solids. Fermentation wastes contain appreciably higher amounts of phosphorus than sewage. Studies pertaining to the effect of various types and different quantities of phosphorus compounds on the dewatering of fresh solids, ripe sludge and the coagulation of digester supernatant, and the effect on sludge volume and water holding capacity of sludges, showed that there was a general relation between the type of phosphates present or added and the filtration time, sludge volumes, and clarification of the liquid. Phosphates precipitated to the greatest degree, produced the highest sludge volumes, the greatest retarding effect on filtration time and the poorest clarification. Sodium phosphate showed the greatest effect.

Electrodialysis of the sludges showed that the coagulant demand is greatly influenced by soluble ions, which can be removed, and that the cations did not affect the coagulant demand of dialysed sludge but that the anions had a pronounced effect. Bicarbonate and ammonia ions did not appear to play an important role, but phosphate ions appeared to be one of the chief controlling factors in dewatering.

Removal of phosphate ions adsorbed on the sludge particles or on the proteinaceous substances present caused instability and increased the filterability with lower quantities of coagulant, indicating that phosphates and protein (or protein salts) are of great importance in connection with dewatering of sludge. Trade wastes containing phosphorus compounds are more difficult to dewater, produce larger volumes of sludge, and hold the water more tenaciously than sewage sludge.[C51]

Treatment of San Francisco's Sewage

Sewage from the northwestern section of this city is being treated at the Sunset plant, the capacity of which is now being doubled. Plans are being prepared for a plant to treat the sewage from all the rest of the city except about 10% of its area in the south-



When selecting blowers, watch that most important point of matching them to the job. Capacity, pressure, floor space and other factors must be carefully considered to give you long-time, satisfactory operation.

That's where R-C *dual-ability* goes to work for you. With small-to-large sizes and many styles of both Centrifugal and Rotary Positive designs, we are completely unbiased in our recommendations. For instance, the high-capacity Roots-Connersville Centrifugal Blowers (illustrated at top, above) best meet the needs of a large sewage plant in a metropolitan area. The small Rotary Positive units in the lower picture, equipped for outdoor operation, furnish ample air for a small, rural plant.

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eastern part, which sewage may later be brought to this plant by tunnel or have a plant of its own. A new plant, called the North Point, is designed to treat an average of 65 mgd by sedimentation. The sludge from this will be pumped for treatment to another plant called the Islais Creek plant, to which filter cake from the Sunset plant also will be hauled by truck for drying.

The Sunset plant will be doubled in capacity, including screening, grease removal, mechanical flocculation, sedimentation, digestion, elutriation and vacuum filtration. All the units will be housed.

The North Point plant will consist of bar racks, screens, grit removal, preaeration-sedimentation tanks and rotating screens for removing any floating particles in the effluent. The effluent will be chlorinated and discharged into the bay through four outlet lines into 30 ft. of water. The sludge and grease, containing 2% solids, will be pumped 6 miles through a 10" line to the Islais Creek plant. Part of the effluent will be pumped through a similar line to that plant to be used in elutriation. The sludge line will be provided with a type of lining intended to prevent the growth of slime in the pipe; also with devices for mechanical cleaning and applying heavy shots of chlorine. At the Islais Creek plant the sludge will be thickened to 4% solids before entering the digestion tanks; the excess water, together with the tank supernatant, waste elutriation water and vacuum filtrate, will be treated in a small separate plant. Ten digestion tanks, with a capacity for the sludge of more than 60 days, will be heated by external heating with circulation in and out of the tanks. The sludge will be washed by countercurrent elutriation and filtered on vacuum filters. The filter cake, together with that from the Sunset plant, will be dehydrated by flash drying and used as fertilizer. Most of the gas from the digesters will be used for tank heating and sludge drying. All of the structures at both plants will be housed, and provision made for ventilation and odor control.[H37]

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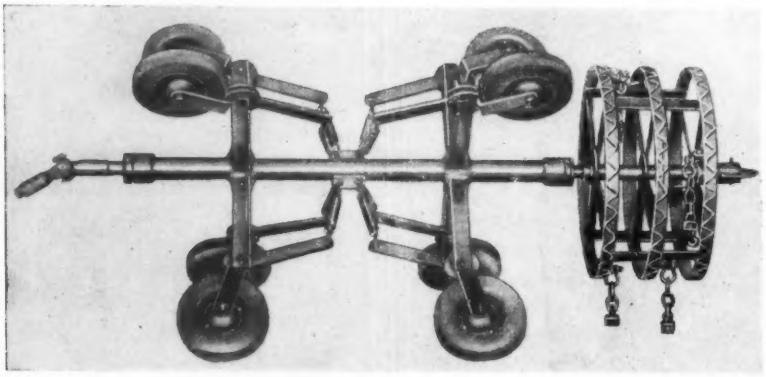

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Machine-Made Sewer Joints

In building trunk sewers as part of a $3,000,000 sewer project of Tacoma, Wash., a new method of jointing the sewer pipes was employed. As much of the sewer was laid below ground-water level and the sewage had to be pumped, tight joints were imperative. Because of the wet trenches, asphaltic-type joints were considered impracticable, and it was decided to use cement "shot" into place like gunite. The standard gunite machine covered too large an area and used too high a working pressure, but a machine for this purpose was invented by Ben Nickolson of Seattle and used most successfully. In this machine the sand and cement, mixed by air jets, are brought to the nozzle by compressed air and water is introduced there. The nozzle delivers a small jet which will enter the joint. In making the joint, it first is washed by water alone from the nozzle. Then the grout is sprayed into it, beginning at the bottom. A 1:2 dry mix is used and the joint material is so dense that an instant after a joint has been completed it can scarcely be dented. It required 5 to 8 minutes to complete a joint in 36" pipe. Joints in a sewer thus laid under a head of several feet of ground water were perfectly tight. The bid for this type of joint was 3% higher than for a standard and mortar joint but it was considered well worth the difference. The labor union required the contractor to employ 4 men on the work—a compresor man, mixer man, machine man, and nozzle man, but the compresor man was unnecessary.[L5]

The 9th Edition Of "Standard Methods"

The Standard Methods Committee of the American Public Health Association reported in June that the 9th edition of "Standard Methods for the Examination of Water and Sewage" was in press, and suggested that a committee to plan the 10th edition be appointed at once; that that edition be published not later than 1950, and that each association interested in standard methods should have a committee devoting its energies to that subject; these including the Am. Chemical Soc'y,

A.P.H.A., A.W.W.A., and F.S.W.A. It was also recommended that the Joint Editorial Board do not confine itself to appraising published methods, but endeavor to develop new and better methods of analysis. Criticism of methods should be sought from all interested parties. The trend toward instrumental methods in analytical procedures is now so strong that such questions should be considered as specifications for the shielding of the various electrodes, wave lengths, etc., and for instruments used in a number of recently applied spectroscopic methods.[X5]

Recovery of Milk Wastes

Where drying and processing facilities are available for recovery of waste milk products, there is no question as to the direct money savings to be realized. Where they are not available, concentrated wastes such as spoiled whole milk, whey, drippings, etc., can be sold or given to the producers for animal feed. Even though direct financial savings from these methods may be slight, the savings in the indirect costs resulting from waste treatment are so marked as to render such practice mandatory.

Not only should the milk loss be reduced, but the volume of process water should also be reduced as much as possible. Investigations along both of these lines should be a preliminary to any plan for disposal. Often savings accomplished will pay for the treatment program in a surprisingly short time.[P19]

Sludge and Effluent Sold to Fruit Growers

Riverside, Calif., in May, 1947, completed a treatment plant which provides chemical precipitation, sedimentation, trickling filtration, two-stage digestion and post-chlorination. Located in a citrus fruit farming area, it finds ready sale for sludge for fertilizer and effluent for irrigation. The digested sludge is dried on beds. Three 175-ft. trickling filters will be operated at first with a loading of 3 mgad and 330 lb. of B.O.D. per acre-ft., to provide for 5 mgd of sewage. When the flow increases much beyond this, the capacity can be doubled by converting them to high-rate filters by adding a primary clarifier, a digester and a recirculation pump.

Ferric chloride for precipitation and ferrous chloride for odor control are made by passing a chlorine solution over baling wire, of which large quantities are available.[E11]

Sewage Treatment For Portland, Oregon

Plans that have been prepared for treating the sewage of Portland provide for an average flow of sanitary sewage of 60 mgd, and include coarse racks manually cleaned, bar screens mechanically cleaned, grinding of screenings; grit removal in 6 trapezoidal channels cleaned by flight conveyors; sedimentation based on 1½ hr. detention, with mechanical collectors; sludge digesters with capacity of 2.5 cu. ft. per capita, the sludge to be preheated by live steam. The sludge, fully digested, will be discharged at a low rate and appropriate times into the Columbia river, or will be sold in liquid form for fertilizer.[H36]

Chromic Wastes And Activated Sludge

The Tallmans Island activated sludge plant, handling an average flow of 18 m.g.d., received more than two tons of chromic acid, calculated as chromium, in an 18-hour period on October 17-18, 1946. The waste had little effect on treatment except that nitrification ceased for about ten days. This actually resulted in a decrease in the effluent B.O.D. The effluent was turbid for several days, probably because of dead organisms, but this turbidity cleared up with the re-establishment of nitrification[C52]

Long Distance Piping of Chlorine

The City Island sewage treatment plant of Atlantic City, N. J., is connected to the main land only by a foot bridge 1,500 ft. long. The plant uses 3,000 lb. of chlorine daily, and use from 150-lb. cylinders was impracticable, as was taking ton containers out to the plant. Housing ton containers on the main land and conveying the chlorine to the plant through 1,600 ft. of undulating pipe exposed to the weather was considered but abandoned because of the probabilities of reliquefaction. The plan adopted was to pipe liquefied

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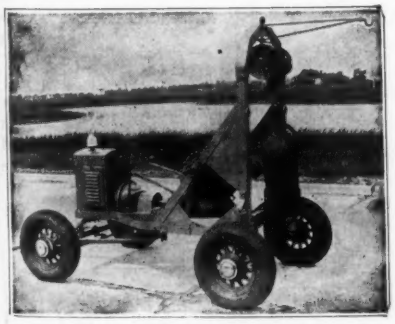

Sewers clogged with sand, roots and other debris are a constant danger to public health and safety. New installations rapidly lose their efficiency due to sand seepage.

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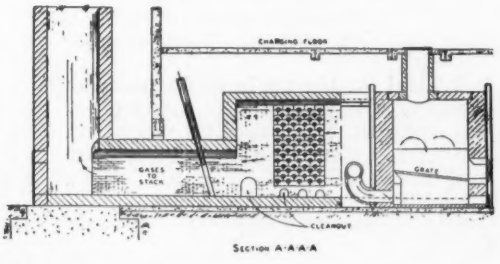

SECTION A-A-A-A

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anhydrous chlorine to the island. As the pressure in the pipe might reach 176 psi., the pipe and fittings were designed to withstand 250 lb. The 1,600 ft. of uninsulated ¾" extra heavy black iron pipe was cleaned with carbon tetrachloride before being used, and all valves and fittings were degreased with the solvent. To provide for a possible temperature range of 140°, which would change the length of the pipe line 17", 5 expansion bends were inserted at equal intervals, using 4-bolt ammonia flanges with compressed asbestos gaskets. Check valves were used, designed to close when liquid chlorine is withdrawn from the tank at a rate exceeding 8,000 lb. per hr.[C53]

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The Ruggles-Coles Class "XA" Dryer, made by Hardinge, has the highest thermal efficiency of any rotary dryer built—due to complete fuel combustion, small radiation loss, and low exhaust temperatures.

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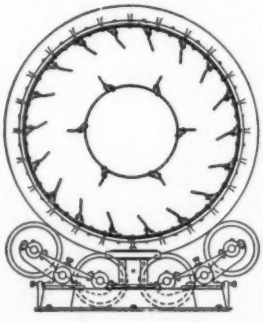

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The Highway and Airport Digest

A Culvert With 17 Arches

Sunset Highway, west of Portland, Ore., crosses a broad, shallow waterway which carries a large peak flow. The road surface is only 6 ft. above the bed of the stream. Under these conditions it was found economical to use, rather than a trestle, 17 corrugated steel pipe arches, the middle one a full round 84" pipe for low-water flow, the others 72" wide by 44" high; all 56 ft. long. A concrete wall 138 ft. long at each end holds the pipes in position, and they also serve as retaining walls for the fill, which extends 24" above the pipe and was hand-tamped under, around and above the pipes.[N57]

Research by Public Roads Administration

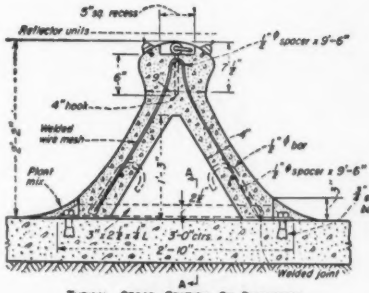
The research laboratory of the PRA is expanding its work in keeping with the large road construction program now under way, carrying on the work in four sections—bituminous materials and mixtures; cement, aggregate and concrete; soil studies; investigations relating to structural design. Results of its studies on use of additives and on rubber-asphalt fillers have already been published in PUBLIC WORKS. Other studies under way include improving the durability of concrete, and the "alkali-aggregate reaction" which produces internal expansion and disintegration. Air-entraining studies include microscopic examination of polished surfaces and thin sections. Study is being made of the abnormal expansion which sometimes develops in concrete due to changes in temperature and moisture content. A 4-year study of blends of natural and portland cements is nearing completion. The physical properties of all types of rock found throughout the United States are being determined. Special machines have been devised for compacting soil samples for moisture-density tests, for measuring the swelling pressure of compacted clay soils when they absorb moisture, and for measuring volume changes of fine-grain soils under repetitive loading. Studies are being made of the effect on impact forces on rigid pavements of each of the four major variables—wheel load, vehicle speed, road roughness, and tire equipment. It was found that normal changes in temperature of concrete slabs can cause stresses as great as those from the heaviest legal wheel load. Electrical resistivity and seismic methods are used for determining depths to rock, to gravel suitable for aggregate, to solid materials under marshy land, etc.[E34]

Panama's New Airport

The U. S. Public Roads Administration has just finished constructing, for the Republic of Panama, an airport 17 miles northeast of the city of Panama. It contains a concrete runway 200 ft. wide and 7,000 ft. long (which can be extended to 10,000 ft.) and 8,000 ft. of 70 ft. taxiway. The runway has a 1.5% transverse crown and a 1.1% longitudinal grade. The end zones are 12" thick, the remainder 10½". Transverse expansion joints are 100 ft. apart, with metal strips at 25 ft. intervals. Concrete was placed in 20 ft. strips, with a longitudinal dummy joint in the center of each. Parking aprons, hangar areas and taxiways are 12" thick.[E33]

Deflector for Sharp Curves

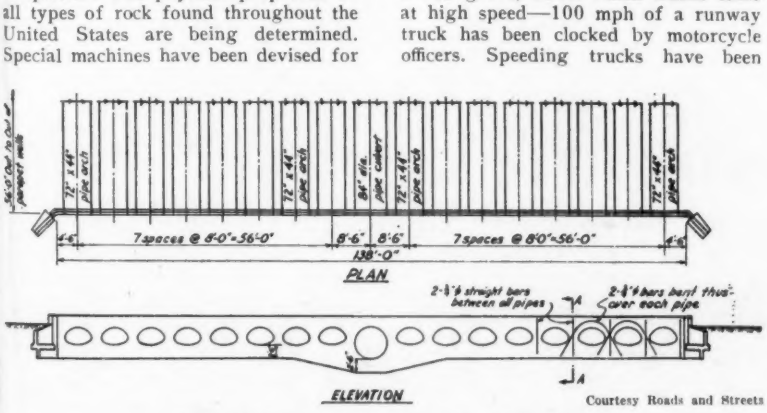
The "Ridge Route" to Los Angeles, Calif., has long stretches of 4 and 5% grades; one curved 5-mile portion has a 6% grade, down which trucks come at high speed—100 mph of a runway truck has been clocked by motorcycle officers. Speeding trucks have been using the median guard rail as a rubbing strip to reduce speed, and it also served to prevent vehicles out of control from crossing over to the other lane on the outside of the curve. The median deflector was of steel and wood and was not substantial enough for the punishment it had to take; and last October the highway commission installed 2,000 ft. of a reinforced concrete one calculated to withstand heavy impacts and prevent trucks climbing over it. The outer surface is smooth so that tires can ride up the deflector easily, warning the driver of his position. The deflector is cast in 10 ft. lengths, weighing about 3,000 lbs., each of which is bolted to the concrete pavement by 6 expansion bolts. Each 10 ft. length carries a central "cat's-eye" reflector that reflects in both directions. The deflector stands 26" above the pavement.[E36]



TYPICAL CROSS SECTION OF DEFLECTOR
Courtesy Eng. News-Record

A Road-Mix Surface After 7 Years of Service

In 1939 a test road 10 mi. long was built by the road-mix method in northern Indiana, in 51 sections using 3 types of bituminous materials, and aggregates from two sources and of several sizes. After 7 years of service the sections were examined, and 2 representative samples from each were analyzed in the laboratory, and the following conclusions seemed warranted: The general success of the road was due to good soil conditions, high-level profile, adequate base, low traffic density, and especially to careful workmanship. The bitumen content, surface area of the aggregates and performance of the different sections varied markedly over a 7-yr. period. The surface texture, even after 7 yrs., is dependent upon the size of aggregate used, even though it degrades very appreciably under traffic. Performance depended more upon size than source of aggregate, the finer and better-graded aggregates producing the best results. Either RC-3, AES-3 or TH gave good results. Since the better-



Courtesy Roads and Streets

Plan and elevation of a culvert with 17 openings.

graded aggregates produced better results but are more difficult to mix uniformly by road-mix methods, and with such methods the bitumen content and aggregate surface area vary markedly, plant-mix methods shuold be considered.[O30]

Sand-Asphalt For Small Airfields

In paving old turf runways on a private airfield for small planes on Staten Island, N. Y., mixed-in-place asphalt was used, costing a little over $1.00 a square yard of 6" compacted depth. The results are apparently satisfactory. Two runways were built, each 2,000 ft. long and 80 and 60 ft. wide, respectively. A sandy loam with a clay content as high as 18%, found on the site. was spread to a depth of 7" over the graded areas, and scarified. The paving unit comprised a Diesel tractor drawing a road-mix machine and an emulsion tank, with a water tank when necessary. This unit picked up,mixed and windrowed 8 ft. width of material, using 3.75 to 3.83 gal. of asphalt emulsion per sq. yd. Half the windrow was then spread and packed to a finished depth of 3" with a multi-wheeled rubber-tired roller followed by a 10-ton steel tandem roller. Then the rest of the windrow was spread and compacted, using a sheepsfoot roller followed by the tandem roller, a compaction percentage of 95 being obtained. A seal coat of ¼ gal. of emulsion then was applied, into which limestone chips were rolled.[N58]

Steam-Cleaning Road Equipment

Sebastian County, Arkansas, steam-cleans all its 55 pieces of road equipment before a major overhaul and before many minor repairs, and cleans wire rope every two weeks. Steam-cleaning wire rope followed by hot bath lubrication adds to the life of the rope. Cleaning a 1½-ton dump truck requires an average of 1.65 hr., and cleaning a 1½-yd. shovel 4 hr. Crater compound used for greasing dipper sticks, and asphalt, are removed by kerosene or a commecial cleaner. Overhauling trucks after steam-cleaning took an average of 47½ hr. of labor, but 64 hr. if not previously cleaned. Parts such as motors, transmissions, etc., are soaked for 45 min. to 1 hr. in a hot solution of a cleaning compound, then steam cleaned. In steam-cleaning, steam is discharged from a hose into which a soap solution is fed by gravity.[N59]

Traffic Flow in Miami, Florida

Following a 3 months' parking and transportation survey, Miami has improved conditions in its downtown area by revision of bus routing and distribution of terminals, revision of the use of curb space, changes in one-way streets, and laning of practically all downtown streets. But routes were changed to make shorter loops and reduce the number of left turns by 51%. Parking and standing of vehicles is prohibited where they would interfere with the movement of traffic. Taxicab stands are given priority over general parking; street parking is confined to those curb spaces which are not needed for other uses, and all-day parking in the central business district is prohibited.[L8]

Backfilling Road Subdrains

For backfilling over and around road subdrains to prevent clogging, Indiana uses material such that the maximum size of the smallest 15% (called the 15% size) should be 5 times as large as the 15% size of the surrounding soil; and the 15% size should be not more than 5 times the 85% size of the soil. When drains with bottom perforations are used, 2" of porous backfill is placed below the drain.

In Illinois, the backfill has the following gradation: passing No. 2 sieve, 100%; passing No. 4 sieve, 30 to 100%; passing No. 50 sieve, 0 to 30%; passing No. 200 sieve, 0 to 5%.

New Hampshire finds clean medium sand or fine gravel best. The gravel should contain 15 to 20% retained on the No. 4 sieve.

Ohio uses two gradations: one, passing ¾-in. sieve, 100%; passing ½-in. sieve, 90 to 100%; passing ⅜-in.

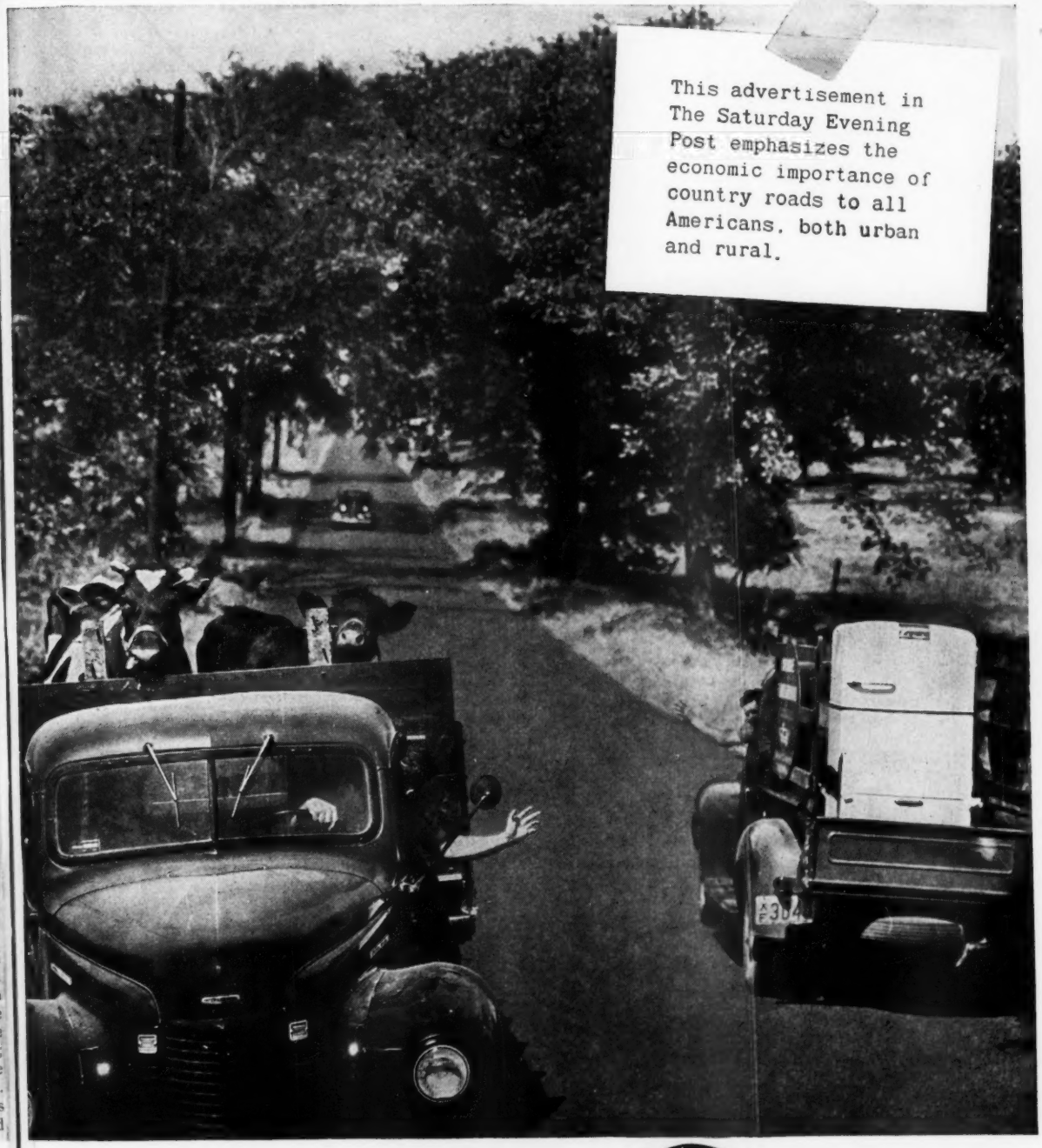
Actual independent tests made by a leading state highway department revealed that the Buffalo-Springfield 3-axle tandem produced a finished highway surface with an average roughness index of 11.1" per mile, the lowest ever recorded for that type of work in that state, as compared to the state average of 21.4" per mile. When rollers are required — buy Buffalo-Springfield for the best.

BUFFALO SPRINGFIELD
THE STANDARD OF COMPARISON
SPRINGFIELD, OHIO

The Oldest and Largest Builder of Road Rolling Equipment in America

When you [illegible] information—consult the classified READERS' SERVICE DEPT., pages 69-73

FARM-TO-MARKET ROADS are *two-way* trade routes. They carry food to cities; manufactured goods to farms. Important to highway officials and engineers in the development of these vital roads is Barrett-Tarvia* road tar, a dependable and economical all-purpose paving material.



This advertisement in The Saturday Evening Post emphasizes the economic importance of country roads to all Americans, both urban and rural.

HOW BARRETT SERVES THE ROAD BUILDING INDUSTRY. Barrett Tarvia* road tar and Tarvia-lithic* bituminous concrete, which have long been favored paving materials of road officials and engineers, meet almost every requirement for dependable, low-cost road construction, maintenance and repair. Barrett also makes Wood Preservatives for guard rails and bridges, Protective Coatings for culverts and underground pipe, and Waterproofing for viaducts and tunnels. These and other Barrett basic products establish Barrett as **ONE OF AMERICA'S GREAT BASIC BUSINESSES.**

Barrett

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

*Reg. U. S. Pat. Off.

TIP TO ROAD MEN: If any of the country roads in your territory need attention, ask the Barrett field man for suggestions He can help you.

When writing, we will appreciate your mentioning **PUBLIC WORKS**

sieve, 40 to 70%; passing No. 4 sieve, 0 to 15%; passing No. 8 sieve, 0 to 5%. The other material meets the following gradation requirements: passing ½-in. sieve, 100%; passing ⅜-in. sieve, 90 to 100%; passing No. 4 sieve, 10 to 35%; passing No. 8 sieve, 0 to 5%.[R20]

Maintenance Needs and Costs

A committee of the Highway Research Board estimates the cost of road maintenance in 1941 was $659,000, and was 35% more than this in 1945. During the war, deferred maintenance accumulated to a total of about 22% measured by man-months of labor. In addition, the states need $47,000,000 worth of new equipment, not including county and city needs.[P24]

Standard Bridge Plans

Minnesota Dept. of Highways prepares standard plans for bridges and culverts on state, state-aid, county-aid and township roads, which total 8,898. Governing factors are strength, width of roadway, type of construction and economy of materials. The aim in each case is to secure the most economical structure, considering the geographical location, first cost, appearance, utility, strength and safety, resistance to fire and cost of maintenance.[R21]

The Case Against Toll Roads

No toll roads, except a few short ones, earn enough to cover all costs, even though the toll charges are high. A toll rate of 1 ct. a mile for a passenger vehicle is equivalent to a gasoline tax of 12 to 16 ct. a gallon; and a fraction of this tax would provide enough funds to build the road as a free public road. A toll road cannot serve vehicles on trips of shorter lengths than the distance between toll gates. In some proposed toll roads this distance averages 25 mi. or more; and 79% or more of all trips out of cities are less than 20 mi. To attract traffic, a toll road must be of higher grade than parallel free roads, therefore cost more, and its bonds must carry a higher rate of interest than those of a public road agency. The gasoline tax is the ideal substitute for, and preventive of, toll financing. By it the user pays for what he gets. User of a toll road pays as much as non-users, and the toll besides.[J8]

In Favor of Toll Roads

Any road must be built, maintained and paid for, usually through some form of general taxation. A toll project is based on the most equitable and direct form—the users pay for it. It is wiser to secure promptly a badly-needed public improvement on this basis than to defer it for years until it can be built by general taxation. A toll project should be made "free" as soon as construction cost has been liquidated by toll collections.[E35]

Bibliography of Highway and Airport Literature

D *The Surveyer*
June 13

18. Asphalt Roads in Hampshire. By A. C. Hughes. Pp. 303-304.

E *Engineering News-Record*
June 12

33. PRA Builds Panama Airport. Pp. 123-124.

June 26

34. Work of Public Roads Research Laboratory. Pp. 64-68.
35. Toll Roads Favored. By E. R. Needles. Pp. 94-95.

July 10

36. Median Deflector for Sharp Curves. Pp. 102, 103.

J *American City*
July

8. The Case Against Toll Roads. By Thos. H. MacDonald. P. 153.

L *Civil Engineering*
June

8. Miami Improves Traffic Flow in Central Business District. By Earl J. Reeder. P. 19.

N *Roads and Streets*
June

54. Is It a Fair Bid? Double Checking Contractors' Bids. By A. E. Johnson. Pp. 51-57.
55. Designing Two-Soil Mixtures. By Geo. W. Shults. Pp. 58, 60, 74.
56. Houston Urban Expressways. By Harold J. McKeever. Pp. 61-69.

Effective ice control in winter is only one of the many jobs that BAUGHMAN Spreaders will do. *'HI-SPEED'* and self-unloading, they save time and reduce material handling costs in rebuilding road shoulders . . . in spreading lime, fertilizer, and crushed stone in parks, airports, and public works . . . in stockpiling sand, gravel, chips, etc. Many similar jobs are just as easy with the BAUGHMAN.

You can attach or remove the spreading mechanism and baffle plates quickly and easily. The BAUGHMAN is ruggedly built of high tensile alloy steel—30% lighter yet 17% stronger and tougher and 5 times more resistant to rust and abrasion than if built of ordinary steel. Result: More payload and less wear and tear on truck. Genuine Timken bearings . . . heavy hardened cut-steel gears. Capacities 9 to 17 cu. yds.

Rebuilding road shoulders the fast, efficient, and economical way.

Write for prices and complete information

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BAUGHMAN MANUFACTURING CO., Inc.
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When you need special information—consult the classified READERS' SERVICE DEPT., pages 69-73

57. Seventeen Arches in This Pipe Culvert. Pp. 80, 86.
58. Mixed-in-Place Sand-Asphalt Emulsion for Airfields. By M. T. Decker, Pp. 83-84.
59. Steam Clean Before Overhauls. By A. E. Moore. Pp. 88, 90, 92, 94.

P *Public Works*
July

22. Protecting Your Airport Investment. By Joseph C. Federick. Pp. 24-26, 66.
23. Building Safety Into Low-Cost Road Junctions and Crossings. Pp. 29-30.
24. Highway Maintenance Needs and Costs. Pp. 56, 58.

R *Better Roads*
June

18. Curb Those Maintenance Hazards. By Wesley W. Polk. Pp. 17-18, 30.
19. Simplified Right-of-Way Procedure. By J. Frank O'Marah. Pp. 19-20.
20. Why Do Subsurface Drains Clog Up? Pp. 22, 34.
21. Standard Bridge and Culvert Plans. By E. J. Miller. Pp. 23-24, 36.
22. Planning for Modern Roads in the Punjab. By B. A. Malik. Pp. 25-28.
23. Good Farm Soil Practices Cut Road Costs. By Abel Banov. P. 32.

Non-Skid Road Surfacing Employs Two Types of Aggregate

Methods employed to provide a permanent non-skid and light-colored surfacing on heavy-traffic streets in Westminster by substituting asphalt for wood paving are as follows: A 2-in. rolled asphalt binder course is laid on the existing concrete base and is followed by a 1¼-in. course of mastic asphalt and a ½-in. wearing course of natural rock asphalt powder covered with pre-coated chippings, consisting of 2 parts of 1-in. basalt and one part of ¾-in. granite. It is hoped that a non-skid surface will be preserved by the differential wear of the two types of chipping. On less heavily-trafficked streets rolled asphalt is laid in two courses and pre-coated granite chippings are rolled in.—*Road Abstracts.*

German Winter Maintenance Practices

The German Todt Organization published in 1942, a 135-page handbook which was intended for the use of German road-maintenance corps during the winter campaigns in the U.S.S.R. It contains comprehensive directions for all aspects of winter maintenance work. The subjects discussed include: Winter conditions in the U.S.S.R. and their effect on the roads; mode of formation of snowdrifts; influence of road design upon snowdrift formation; formation of field meteorological stations to report on weather conditions and the state of the roads; fences for protection against drifting snow; snow clearance by hand labor, horse-drawn wooden plows, lorry- and tractor-drawn plows, and rotary plows; formation of mobile snow-clearance sections, including the plant and machinery required; treatment of icy roads; organization of winter maintenance corps stations; and the work to be done when the spring thaw begins. An appendix includes direction for servicing motor vehicles in winter.—*Road Abstracts.*

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3-5 TON
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General and Export Offices
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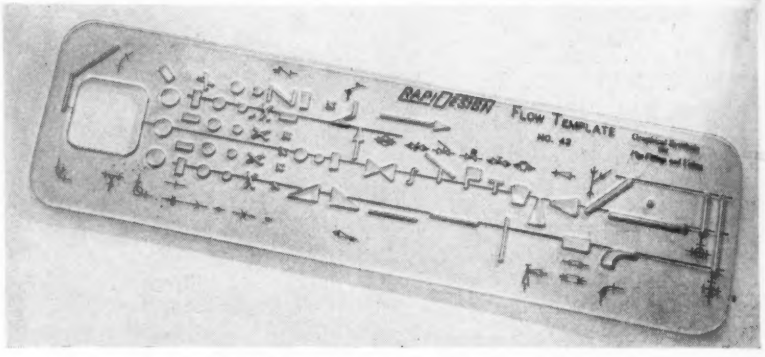
PUBLIC WORKS Equipment News

This Will Help in Your Piping Layout Work

Here is a template to help in rapid layouts of water, oil, gas or plumbing pipe. It has cut outs for all symbols shown in the American Standards Manual Z32.2. Made of plastic, with laminated printing and symbol cut outs beveled. For information write Charles Baron, Rapidesign, Inc., Box 592, Glendale, Calif.



Rapidesign template for piping layouts.

An Air Compressor for Municipal Utilities

An 105-cfm. utility compressor is under production by LeRoi Co., Milwaukee, Wisc. This unit is entirely self-contained and weighs only 1,700 pounds. It has been specially designed for either back-of-cab or on the platform of utility trucks. It is liquid cooled. Floor area required is 82"x25". Descriptive literature with more details on request.

How to Weigh Dry Materials on Conveyor Belts

The Conveyoflo meter, by Builders-Providence, Providence, R. I., should have wide applicability. It will weigh stone, gravel, cement, powdered chemicals and sludge. The scales may be used to proportion and control as well as to weigh, and will handle in this manner one or more dry materials, or will proportion the flow of liquids to the flow of dry materials. This meter utilizes diaphragms, instead of knife-edge-beams, and occupies little space; it is also simple. Automatic compensation is made for variations in belt weight or the adherence of material to the belt.

Diesel Generating Sets for Plane Landing Equipment

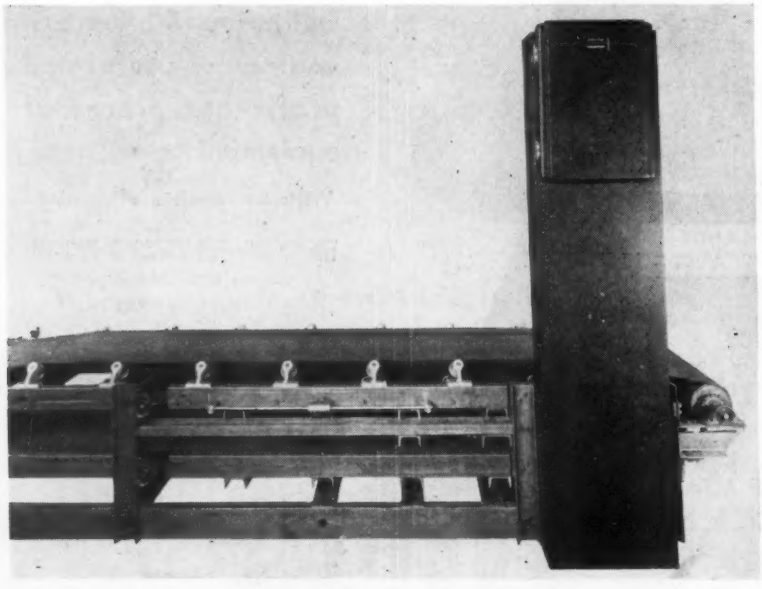
In making automatic plane landings, a dependable and stable source of power is necessary at the field. Sheppard diesel driven generators produce 60-cycle power, with 115 volts, AC, with a stability of plus or minus 1 volt and plus or minus ½ cycle. These units can also be expected to deliver up to 5,000 hours of steady service between major overhauls.

Two Cities Award Incinerator Contracts

Troy, N. Y., is building a 250-tbn Nichols mechanically stoked incinerator of the monohearth type; and Jacksonville, Fla., has awarded a contract for a 350-ton incinerator of the same type.

Installing Timber Connectors

A booklet has been issued by Timber Engineering Co., 1319 18th St., N. W., Washington, D. C., which illustrates and describes the installation of split rings and shear plates for wide span roof trusses and other heavy structures; and also toothed rings for light structures. Sent on request.



To weigh dry materials on conveyor belts.

FOR SALE

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NW—80D Shovel and Drag
NW—95 Dragline Diesel
Insley K-12 ½ Crane and Backhoe
B-E 10-B Shovel
Lorain 40 Shovel
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Buckeye C-15, 12, 11, 140
Cleveland Model 110
Cleveland Pioneer Trencher
Cat. D-4 Angledozer
D-6, 7, 8 Bulldozer

Inquire about our finance plan.

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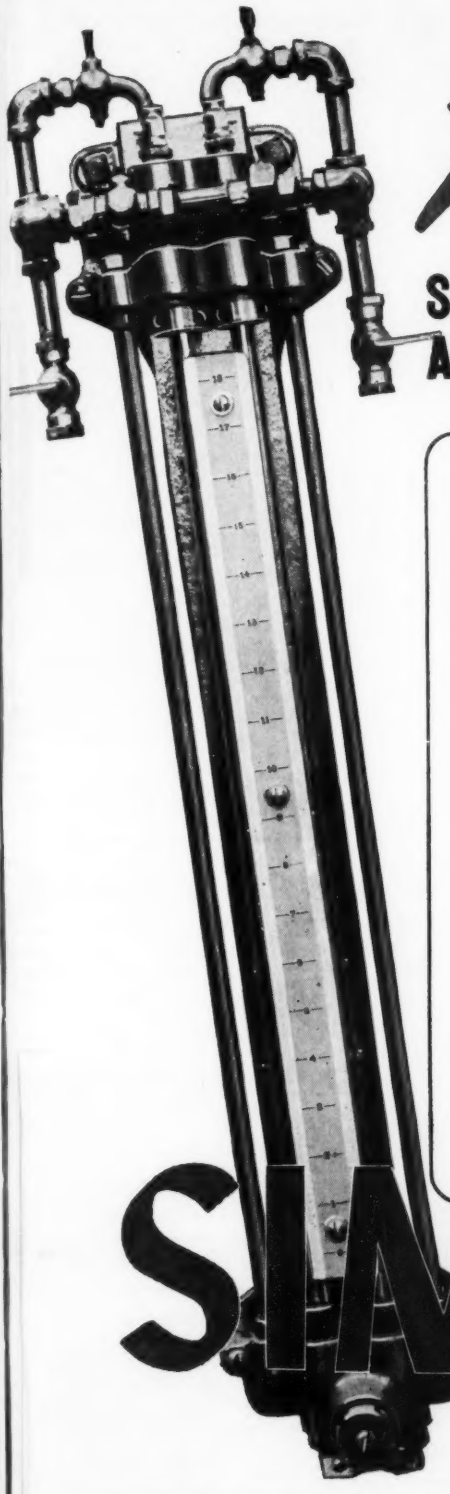
19614 Nottingham Rd., Cleveland 10, Ohio



here's how

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Be sure of accuracy — with a Simplex Type MAP Manometer! This unit has been designed especially to meet the high standards of laboratory technicians, test floor engineers, and other industrial users *where accuracy is a "must"!* Here are six of the special features of the Type MAP Manometer:

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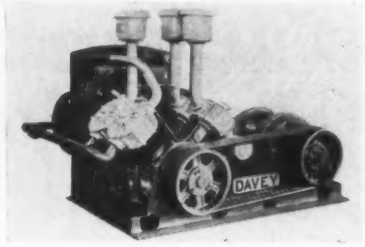
Industrial Air Compressor by Davey

Two-stage, air-cooled, industrial-type air compressors have been announced by Davey Compressor Co., Kent. O. These are made in 60, 105, 160, 210 and 315 cfm. capacities, and in four types: Base compressors; stationary units with base ready for installation for electrical

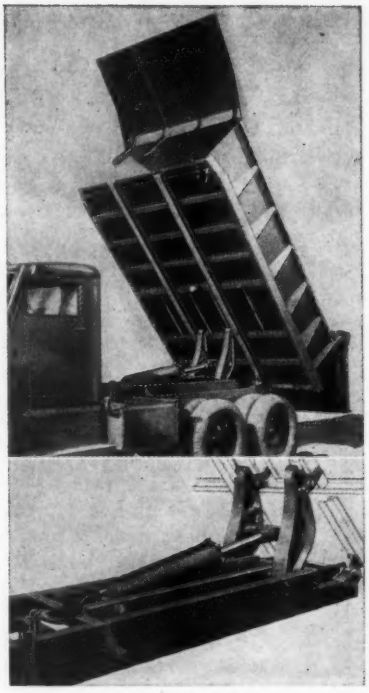


Davey compressor.

equipment; compressors for AC motors; and compressors for DC motors. A special balanced crankshaft and rubber vibration mounts reduce vibration and make it easier to move the units from one location to another.

Dump Bodies and Hoists for Rugged Service

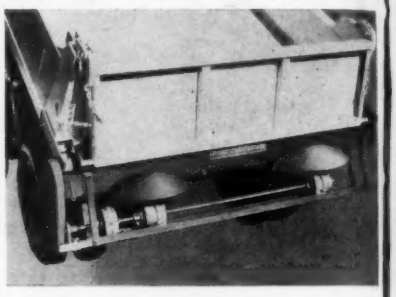
A new series of dump bodies and hoists for heavy-duty service has been announced by Perfection Steel Body Co., Galion, O. The dump bodies—the 300-series—are of 8-gauge sheet steel, heavily braced, and with substantial understructure. The "827" hoist is a special design of this company which gives greatest leverage at the beginning of the stroke, when the lift is heaviest. The bodies are made in 2 to 12-yd. sizes.



Perfection dump and hoist.

Strength and Behavior of Riveted Joints in Steel Structures

Investigations are being made, under the sponsorship of the Engineering Foundation, at Illinois and Northwestern Universities, of the strength and behavior of riveted and bolted joints for steel structures. The work will include static and fatigue strength of joints with various rivet patterns, using hot-driven and cold-driven rivets, and carbon and alloy steel bolts.



This shows the hydraulic road sander made by the Hydro-Spreader Corp., Milwaukee. See p. 59 of our June issue for description.

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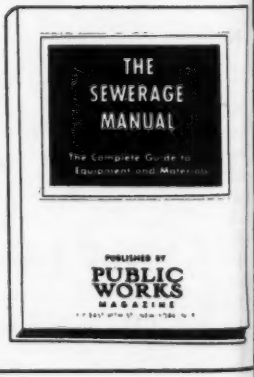
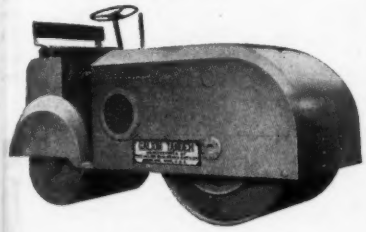


An Easy-to-Operate Small Tandem Roller

A 3 to 5-ton tandem roller has been added to the Galion line, which now includes, in addition to the new roller, 5-8, 8-12 and 10-14-ton tandem units. All four sizes have the "variable weight" feature. The metal weight of the new unit is 7,120 lbs., and the ballasted weight 10,520 lbs. Fully ballasted, compression under the main roll is 170 lbs. per inch width of roll, and under the steering roll, 85 lbs. Both rolls have front and rear scrapers and mats; and



Galion tandem roller.

a 50-gallon water tank is provided for sprinkling the rolls. All controls are convenient; power is by a 25-hp. air-cooled motor. Write Galion Iron Works & Mfg. Co., Galion, O., for complete information.

New England Water Works Association

The following have been nominated for officers of the New England Water Works Association for the coming year: Donald C. Calderwood, president; Sidney S. Anthony, vice-president; Thomas R. Camp, director; and William P. Melley, treasurer.

Alabama Water & Sewage Works Assn.

The Alabama Water & Sewage Works Assn. met at Tuscaloosa, Ala., June 12 to 14, elected officers and carried on a conference and short course. W. H. H. Putnam of Birmingham was elected president; Tom Collins of Ozark, vice-president; Alex O. Taylor of Alabama Polytechnic Institute (re-elected), secretary; Gilbert H. Dunstan, University of Alabama (re-elected), treasurer; and Charles White of the State Board of Health, editor.

National Clay Pipe Mfrs., Inc., Meet at Akron

More than 100 members of the National Clay Pipe Mfrs., Inc., an association of 44 of the leading clay pipe companies, met at Akron, O., June 11 to 13, to discuss business outlooks and problems for the industry. G. Lawrence Avery, head of the Lehigh Sewer Pipe & Tile Co., Fort Dodge, Ia., is the new president of NCPMI. Discussion of construction costs indicated that current costs of clay pipe are only 10% above the 1926 costs, which is far below the average 78% increase of all building materials.

CONCENTRATED *Engineering* IN CONCRETE CONSTRUCTION

HIGHWAYS The heavy duty highway and airport forms have several exclusive Heltzel features . . . 2½" tread . . . up-turned base flange — 50% additional strength . . . extended lock joint guide . . . hot pressed ¼" lock joint — V type eliminates clogging . . . non-clogging single wedge stake pockets that are not affected by vibration. The base flange is also drilled for auxiliary stakes or bolting on risers. The $\frac{7}{12}$" form is recommended for all construction up to 20' widths. The ¼" form is recommended for construction over 20' in width. Both forms meet all highway specifications.

CURBS

CURB AND GUTTER

SIDEWALK

AIRPORT Heltzel also has steel forms for curb, combined curb and gutter, sidewalk, rigid radius and flexible radius.

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Name_____

Address_____

(Type of construction usually engaged in)

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Heltzel BUILDS IT BETTER

- BINS, Portable and Stationary
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- CURB AND GUTTER FORMS
- SIDEWALK FORMS
- SEWER AND TUNNEL FORMS
- CONCRETE BUCKETS
- SUBGRADE TESTERS
- SUBGRADE PLANERS
- TOOL BOXES
- FINISHING TOOLS FOR CONCRETE ROADS

When you need special information—consult the classified **READERS' SERVICE DEPT.**, *pages 69-73*

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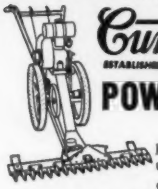

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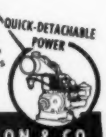

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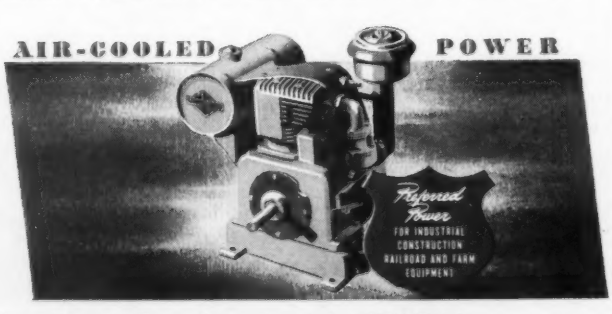

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PERSONNEL NEWS

John T. Woodson has been appointed district representative of the Eddy Valve Co., with offices in the Independence Building, Charlotte, N. C.

Harold L. Hoefman has been elected vice-president in charge of manufacturing of Link-Belt Co., with headquarters in Chicago.

George Toth has joined the sales staff of R. H. Sheppard Co., manufacturers of diesel engines, and has been assigned to the southern territory.

Carl V. Fulkerson has been appointed field engineer of the U. S. Stoneware Co., Akron, O., manufacturers of corrosion-resistant materials, including ceramics, rubber and plastics.

George H. Jennings, structural engineer, has joined *James J. Walsh,* under the firm name of Walsh, Jennings & Associates, Consulting Engineers, with offices at 112 Market St., San Francisco 11, Calif.

Edwin J. Kelly has opened an office for the practice of consulting engineering, with offices at 20 North Wacker Drive, Chicago 6, Ill.

Hardinge, Inc., York, Pa., has changed its San Francisco district office to 24 California St., San Francisco 11, Calif.

THE ENGINEER'S LIBRARY

The Chemical Consultant and Your Business, 1947 edition. Foster D. Snell, Inc., 29 West 15th St., N. Y. Free. Presents an outline of many of the types of problems for the chemical consultant, including rubber and plastics investigations, organic synthesis, analytical service, physical testing, bacteriological analyses, pilot plant operations, chemical engineering, legal testimony and patents.

Building Maintenance Guide

"Over the Rough Spots," a new 48-page handbook provides the answers to more than a hundred problems inherent in the maintenance and construction of all types of industrial buildings. Full information about floors, walls, foundations, roofs, etc.; this practical booklet is a guide for building owners and operators in obtaining economical, serviceable maintenance, and also includes pages dealing with the special problems of public utilities and water works. A free copy of this guide to better building maintenance may be obtained by addressing the Stonhard Company, 401 North Broad Street, Philadelphia 8, Pa.

Florida and Cuba Sections, AWWA

These sections of the AWWA will hold a joint meeting in St. Petersburg, Fla., Nov. 20-22, at the Suwannee Hotel. A. P. Black, University of Florida, Gainesville, is secretary.

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Got a Building Maintenance Problem?

542. Whether it is floors, walls, foundations, roofs, "Over The Rough Spots," Stonhard Company's new free 48-page booklet is packed with practical answers. Address, Stonhard Co., 883 Terminal Commerce Bldg., Philadelphia 8, Pa.

Need an Efficient, Economical Air Compressor?

543. Davey Air Compressors, either trailer type or truck mounted, offer efficient and economical operation. For details on models 105 and 210 write Dept. P.W., Davey Compressor Co., Kent, Ohio.

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606. Gives fast, accurate sizing of test samples. The Gilson Testing Screen handles a large sample in three to five minutes. For bulletin giving complete details on this screen which has a size range from 4 inches to 200-mesh write Dept. P.W., Gilson Screen Co., Box 186, Mercer, Pa.

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110. Powerful self-contained gasoline hammers illustrated in new booklet. Used as paving breakers and spike drivers. Easily portable, economical. Write Syntron Co., 660 Lexington, Homer City, Pa.

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Reliable Every Purpose Pumps

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

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392. 20-page catalog P.W. describes "Dieselectric" plants 3 to 10 KVA, and diesel engines from 4 to 12 H.P. These are easily transported and will produce reliable, low cost light and power anywhere. Write WITTE ENGINE WORKS, Division of Oil Well Supply Company, Kansas City 3, Mo.

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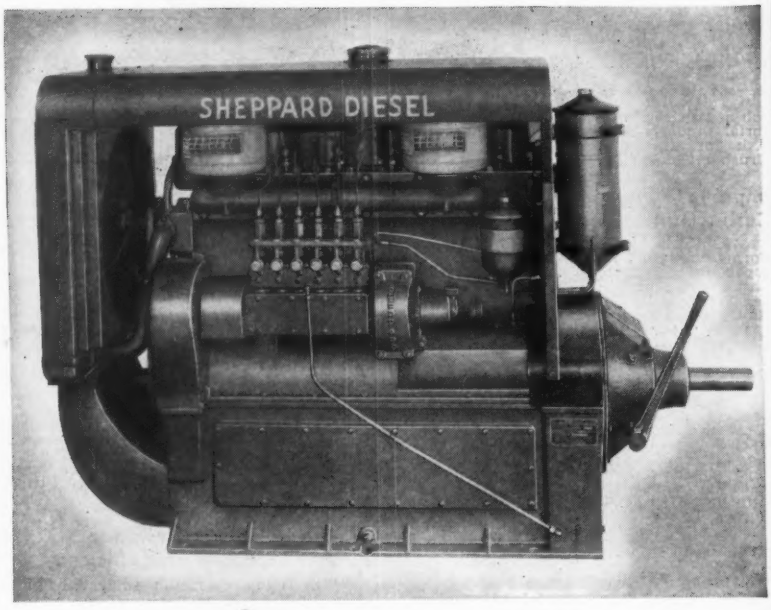

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Tandem, 3 Wheel and 3 Axle Road Rollers

138. "The Buffalo-Springfield" line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog P.W. issued by the Buffalo-Springfield Roller Co., Springfield, Ohio.

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How Cities Can Do Complete Sewer Cleaning From Street

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

All About Flow Meters

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How to Select Main Line Meters

432. New bulletin illustrates Builders Air Relay system for liquids containing suspended solids like sewage. Eliminates corrosion, clogged pipes, etc. "The Selection of Main Line Meters," a highly informative and useful presentation, describes forms of differential producers and quickly solves typical problems with the use of graphic charts. Write Builders-Providence, Inc., Dept. P.W., 9 Codding St., Providence 1, R. I.

How to Make Better Sewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

How to Get Automatic Removal of Screenings

460. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and inclined types). Link-Belt Co., Dept. P.W., 2045 W. Hunting Park Ave., Philadelphia 40, Pa.

An Incinerator Necessity

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Dept. P.W., Plainfield National Bank Bldg., Plainfield, N. J.

How You Can Dispose Of Sewage Solids

464. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes—a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Dept. PW, Nichols Engineering and Research Corp., 60 Wall Tower, New York 5, N. Y.

Ask for This Design Data On Sprinkling Filters

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How the Hydro-Treator Works

486. 28-page catalog describes and illustrates the Dorrco Hydro-Treator, a self-contained water treatment unit combining Flocculation, Sludge Thickening and Clarification. Reduces treatment time and lowers plant construction costs. The Dorr Co., Dept. P.W., 570 Lexington Ave., New York 22, N. Y.

Packaged Sewage Treatment— Just Right for Small Places

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Look Into This Sewage Treatment Equipment

490. New bulletin P.W. fully describes and illustrates Hardinge sludge collectors for clarifiers, sludge concentration and skimming in both circular and rectangular tanks. Write Dept. P.W., Hardinge Company, Inc., York, Pa.

Need Equipment for Small Sewage Plant?

491. Small type Conveyor Sludge Collector and Skimmer, Grit Collector, Aero-Filter and other equipment for small sewage treatment plants are described and illustrated in bulletins from Chain-Belt Co., 1722 West Bruce St., Milwaukee 4, Wis.

Glazed Clay Blocks for Trickling Filter Underdrains

492. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National Fireproofing Corp., Pittsburg 12, Pa., for free copy.

Engineering Details of Armcre Filter Blocks

525. Engineering bulletin shows construction details of Armcre Filter Bottom Blocks for better trickling filter results. Tells how Armcre blocks meet all requirements. Write to Ayer-McCarel-Reagan Clay Co., Brazil, Ind.

For Completely Successful Trickling Filter Systems

526. Armcre Filter Bottom Blocks by BOSCO. 12-page illustrated booklet explains how Armcre blocks meet every requirement for successful trickling filter operation. Gives full specifications and construction details. Includes use for Bio-Filtration. Write Bowerston Shale Co., Bowerston, Ohio.

One-Unit and Two-Unit Vitrified Floor Systems

527. Metro one-unit and two-unit vitrified clay blocks for trickling filter floors are described in illustrated catalog. Includes construction drawings, pictures and complete specifications. Ask for your copy today. The Metropolitan Paving Brick Co., Canton, Ohio.

All About Translot Filter Bottom Blocks

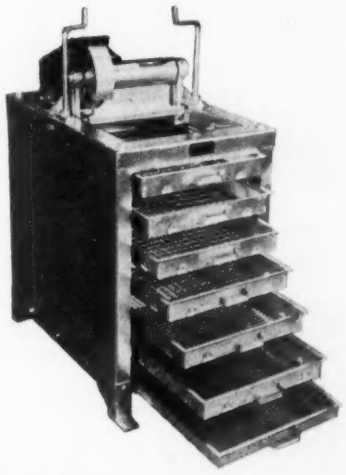
528. Illustrated Engineering Bulletin gives full data about Translot Filter Blocks for Trickling Filters. Shows typical sections, installation views, etc. Write Cannelton Sewer Pipe Co., Cannelton, Ind.

USE COUPON ON PAGE 69

GILSON
Mechanical Testing Screen

Gives You Fast Accurate Sizing of Test Samples:

• Crushed Stone • Gravel • Slag • Similar Materials



The GILSON Testing Screen handles a large and representative sample in three to five minutes. Compact smooth operating unit is designed for testing and research over a wide size range from 4-inch to 200-mesh. An attachment for testing sand is optional. You need this practical method of plant control.

8 GILSON FEATURES

1. Makes tests quickly and accurately.
2. Two to seven separations simultaneously.
3. One machine for the entire size range.
4. Screen trays independently removable.
5. Trays adjusted to same tare weight.
6. Visible separation to refusal.
7. Few moving parts to wear out.
8. Engineered for long and practical service.

Write for bulletin and complete details

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This instrument takes the guesswork out of setting rates of flow in water meter testing.

★

Indicates instantly and accurately the rate of flow in gallons per minute. Can be used with any type of testing equipment.

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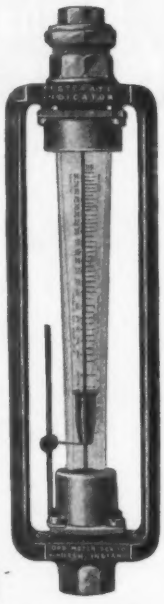

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405 SOUTHWEST BLVD., KANSAS CITY 10, MO.

Low Cost Air for Sewage Disposal

602. All interested in low cost air for sewage disposal will want a copy of this useful booklet. Describes operating principles and specifications of Roots-Connersville Aerating Blowers. Write to Roots-Connersville Blower Corp., 301 Valley Ave., Connersville, Ind.

WATER WORKS

Hydraulic Pipeline Scraper For Water and Sewage Mains

382. For a copy of this compact folder on a hydraulic pipeline scraper which cleans all kinds of mains from 4 inches to 14 inches write to Dept. PW, Carver-Stimpson Pipe Cleaning Co., Walters, Okla.

Full Data on Method and Results Of Water Main Cleaning

383. Water main cleaning by the National Method is title of 4-page folder describing methods and results obtained, with full data. National Water Main Cleaning Co., 30 Church St., New York 7, N. Y.

For All Water Tank Maintenance Troubles

389. For all water tank maintenance troubles, whether the need is for repairs, painting, welding, or cleaning, get latest literature of Chicago Tank and Bridge Co., 618 Empire Bldg., Rockford, Ill.

Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

Make Water Extra Safe

399. Safe water may be one of the civic improvements your citizens expect soon. Feeders of all types including Hypochlorinators, Reagent Feeders, Dry Chemical Feeders, Chlorinators and Ammoniators for feeding all of the usual chemicals used in sanitation practice. Ask for latest catalogs. Dept. P.W., Wallace & Tiernan Co., Newark 1, N. J.

Helpful Data on Hydrants

405. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

The Hydrants With Knuckle Joints

408. Fire Hydrants. "Defender" hydrants of 4" and 5" sizes with knuckle joint horizontally moving valve, easily removed for repair. Send for big new catalog P.W. Rensselaer Valve Company, Troy, N. Y.

Chem-O-Feeders for Automatic Chemical Feeding

400. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. %, 96 Codding St., Providence 1, R. I.

It's Easy to Use This Leak Locator

426. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P., Reading, Mass.

Makes Underground Pipe Installations Easy

444. One-man-operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117, Greenlee Tool Co., 2042 Columbia Ave., Rockford, Ill.

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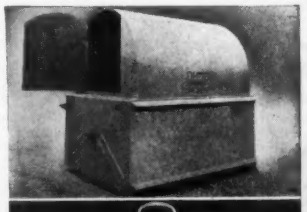

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USE COUPON ON PAGE 69

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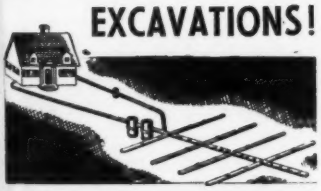

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Concrete Pipe With Greater Elasticity

442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere, N. J.

How to Estimate Quantity Of Joint Compound Needed

450. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Adv. Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Oil or Water Lubricated Turbine Pumps

456. Oil lubricated turbine pumps with open impellers. Five types of heads available. Specifications and illustrations in new bulletin 6930M-2 issued by Fairbanks, Morse & Co., Dept. P.W., 600 So. Michigan Ave., Chicago 5, Ill.

Want Clear, Soft, Iron-Free Water?

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Have You a Water Conditioning Problem?

481. Installation-tested equipment for complete municipal and industrial systems or individual units. Illustrated and described in latest booklets from Dept. P.W., American Wells Works, Aurora, Ill.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

How to Stabilize Lime Softened Water

498. Engineering Bulletin describes stabilizing lime-softened water by recarbonation, discusses gas production, washing, compressing, drying, and applying the CO (2). Infilco, Inc., 325 West 25th Place, Chicago 16, Ill.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

Here's Data on All Swimming Pool Needs

508. Well illustrated bulletin describes Filters, Water Softeners, Hydrogen Ion Plants and Complete Equipment for Swimming pools, etc. Copy sent on request by Dept. PW., Chemical Equipment Co., 223 Center Street, Los Angeles 54, Calif.

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Stonhard Resurfacer makes repairs to wood or concrete floors easy. Your handy man can quickly install **Stonhard Resurfacer** at a thickness of only ½" right over the old, worn floor surface.

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Outdoor Water Service Devices that bear the name MURDOCK are the world's best.

Sturdy, long lasting, dependable, non-freezing. Make practically no trouble. Low upkeep.

Plain to see, therefore, why Water Supts. and Engineers have high regard for "Genuine Murdock."

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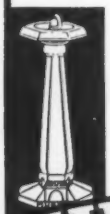
Cincinnati 2, Ohio



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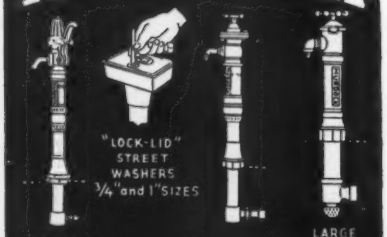
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Applications should be made to Civilian Personnel Branch, Office of the Chief of Engineers, Building T-7, Gravelly Point, Virginia. Applications should include completed Form 57, U. S. Civil Service Commission, in duplicate, copies of which can be obtained at your local post office.

Sanitary engineer wanted for rodent investigation work. Long-time project of research by large eastern university. Write AW, care the Editor of this magazine for information.

Sanitary engineer needed for understudy to chief operator of a large sewage plant in the East. Write AW, care the editor, this magazine for further information.

Sanitary engineers, with experience in state health department work, wanted by long-established company making water and sewerage equipment. Write DWG, care the editor, this magazine for complete information.

Assistant professor of sanitary engineering wanted for college in Rocky Mountain area. Write JEC, care the editor, this magazine, who will forward all letters.

Klassen Receives Army Commendation Award

Clarence W. Klassen, Chief Sanitary Engineer of the Illinois Department of Public Health, has received the Army Commendation Award, as follows: "For meritorious achievement as liaison officer in the Office of the Surgeon General to the War Manpower Commission in charge of procurement and assignment of sanitary engineers for the Sanitary Corps of the Army; he demonstrated exceptional ability, initiative, diplomacy and devotion to duty in organizing the effective program which was productive of filling the needs of the Army, and thus contributed most significantly to the preventive medicine program of the Army. . . ." (Ed. Note: Mr. Klassen's work was much broader than that outlined, but the Army could reward him for only that part of his work which referred to the Army.)

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A1 Salesman—Mechanical Equipment — To Old and New Distributors—Eastern Half United States—Permanent Position—Salary $10,000 to $20,000. Baughman Manufacturing Co., Jerseyville, Ill.

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Because—

They Cannot Clog as Solids Do Not Pass the Impeller

"Flush-Kleen" pumps provide automatic, trouble-free service in sewage lift-stations. They require no manual attention except periodic lubrication and inspection and no labor is required for disassembling and cleaning clogged pumps as with other types.

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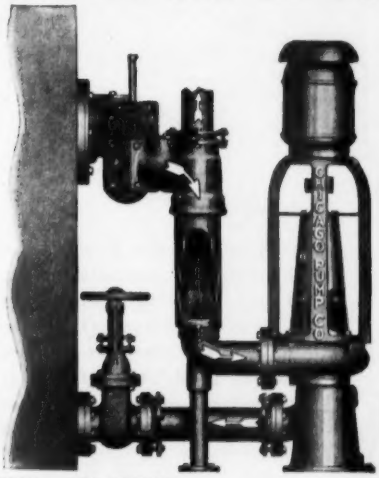
Duplex "Flush-Kleen" Sewage lift Station at Braintree, Mass. Each pump discharges 400 G.P.M. against 65 ft. head.

"Flush-Kleens" operate alternately



Filling Wet Well

- Sewage flows through inlet pipe.
- Coarse matter is retained on strainer.
- Strained sewage flows through idle pump to wet well.

Pumping

- Strained sewage is pumped from wet well.
- Coarse matter is backwashed from strainer.
- Special check valve closes; sewage and coarse matter are pumped to sewers.

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Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminuters.

VOL. 78 — PUBLIC WORKS — No. 9

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SEPTEMBER

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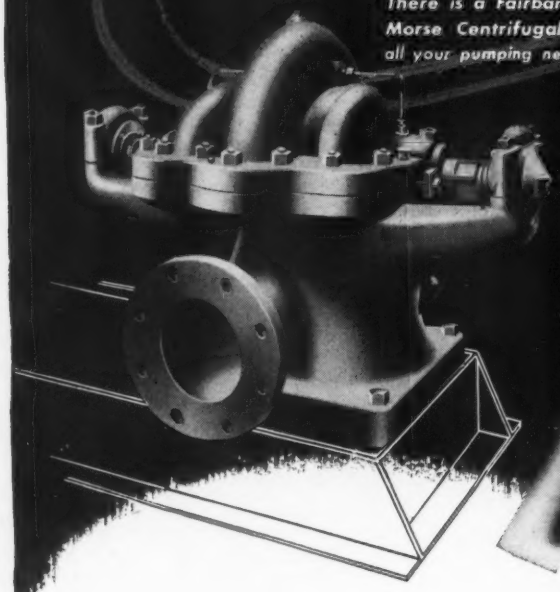
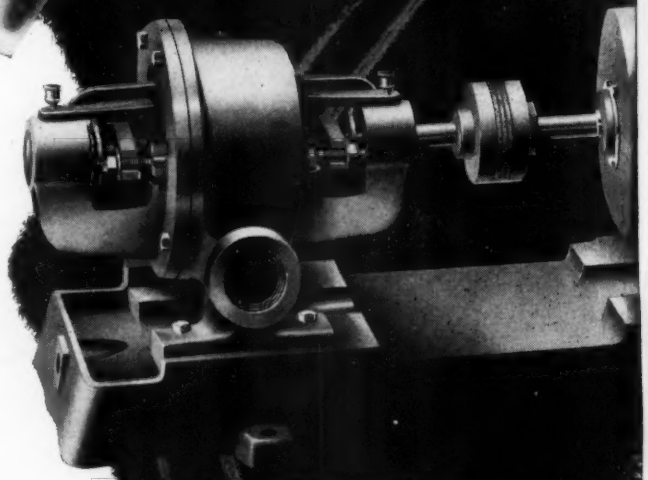
There is a Fairbanks-Morse Centrifugal for all your pumping needs.



Fairbanks-Morse-Pomona deepwell turbine pumps. Oil or water lubricated; open or closed impellers—as your job requires.



Famous Westco turbine-type pumps have exclusive advantages for service involving small capacities, high heads and low speeds.

The values in doing business with one of the hundreds of well-established, progressive Fairbanks-Morse pump dealers are many:

***First,* of course, you gain immediate advantages from the intensive research, skilled productive techniques and well-developed service organization that have long been identified with the Fairbanks-Morse name.**

Too, you gain the long-term advantages of continued aid in keeping your pumps on the job—continued benefits from the widespread, quickly available Fairbanks-Morse dealer organization.

For a pump that's to give high efficiency year after year, buy from the dealer who will stand by you, year after year. See your Fairbanks-Morse pump dealer for all your pumping requirements.

FAIRBANKS-MORSE

A name worth remembering

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